LuK Lamellen und Kupplungsbau Beteiligungs KG
Industriestraße 3
77815 Bühl

0790

Patentansprüche

1. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem nachgeschalteten Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und einer Eingangswelle des Getriebes ein geteiltes Schwungrad mit zumindest zwei gegeneinander entgegen der Wirkung einer Energiespeichervorrichtung relativ verdrehbaren Massen angeordnet ist und zumindest eine der Massen mit der Kurbelwelle und zumindest eine Masse mit einer Eingangswelle des Getriebes unter Zwischenschaltung einer Reibungskupplung verbindbar ist.

2. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und einer Eingangswelle des Getriebes ein hydrodynamischer Drehmomentwandler angeordnet ist und dieser hydrodynamische Drehmomentwandler mittels einer Wandlerüberbrückungskupplung überbrückbar ist.

3. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei zwischen einer Kurbelwelle der Brennkraftmaschine und zumindest einer Eingangswelle des Getriebes zumindest eine Reibungskupplung vorgesehen ist, die mittels eines hydraulischen Ausrücksystems, zumindest bestehend aus einem hydraulischen Nehmerzylinder, einem hydraulischen Geberzylinder und einer diese verbindenden hydraulischen Leitung, betätigt wird.

4. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, sowie einer eine Kurbelwelle der Brennkraftmaschine und eine Getriebeeingangswelle des Getriebes verbindende Drehmomentübertragungseinrichtung, wie Reibungskupplung oder hydrodynamischer Drehmomentwandler, wobei in zumindest eine Wange der Kurbelwelle ein Schwingungstilger zur Verminderung von Drehungleichförmigkeiten der Brennkraftmaschine vorgesehen ist.

5. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem bezüglich seiner Übersetzung kontinuierlich verstellbaren Umschlingungsmittelgetriebe, bestehend aus einem Getriebeeingangsteil mit einem ersten Kegelscheibensatz und einem Getriebeausgangsteil, mit einem zweiten Kegelscheibensatz sowie einem endlosen, beide Kegelscheibensätze umschlingenden Umschlingungsmittel, wobei jeweils eine Kegelscheibe eines Kegelscheibensatzes gegenüber einer zweiten Scheibe des Kegelscheibensatzes axial mittels hydraulischen Drucks verlagerbar ist.

6. Kraftfahrzeug mit einem Antriebsstrang, insbesondere nach Anspruch 5, dadurch gekennzeichnet, dass das Umschlingungsmittel aus einer Kette gebildet ist, die aus in Laufrichtung hintereinander folgenden Laschenverbänden besteht, die quer zur Laufrichtung von Stegen durchdrungen werden, wobei diese Stege an ihren axialen Enden jeweils in Reibeingriff mit den beiden Kegelscheiben eines Kegelscheibenpaares stehen.

7. Kraftfahrzeug mit einem Antriebsstrang, insbesondere nach Anspruch 5, dadurch gekennzeichnet, dass das kontinuierlich verstellbare Umschlingungsmittelgetriebe Teil eines leistungsverzweigten Getriebes ist.

8. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine und einem Getriebe, wobei das Getriebe ein Kurbelgetriebe ist.

9. Kraftfahrzeug mit einem Antriebsstrang, einer Brennkraftmaschine und einem Getriebe, wobei das Getriebe ein automatisiertes Schaltgetriebe mit zumindest einer Getriebeeingangswelle ist und die Schaltvorgänge mittels einer Aktorik erfolgen, die zumindest aus einem Elektromotor gebildet ist.

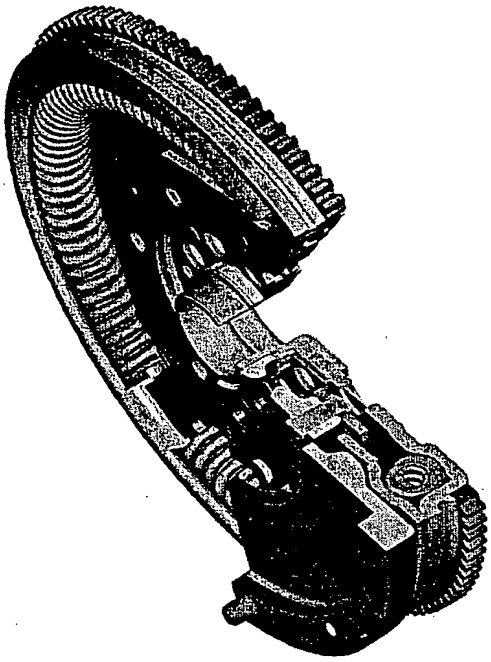
10. Kraftfahrzeug mit einem Antriebsstrang, mit einer Brennkraftmaschine mit einer Kurbelwelle und einem Getriebe mit zumindest einer Getriebeeingangswelle, wobei eine Elektromaschine mit der Kurbelwelle und/oder der Getriebeeingangswelle koppelbar ist.

11. Kraftfahrzeug mit einer Pumpe zur hydraulischen Versorgung von Lenkungssystemen und/oder Fahrwerkssystemen und/oder Getriebesystemen, insbesondere Flügelzellenpumpe oder Radialkolbenpumpe oder Zahnradpumpe, wobei die Pumpe Einrichtungen zur Regelung des Volumenstroms aufweist.

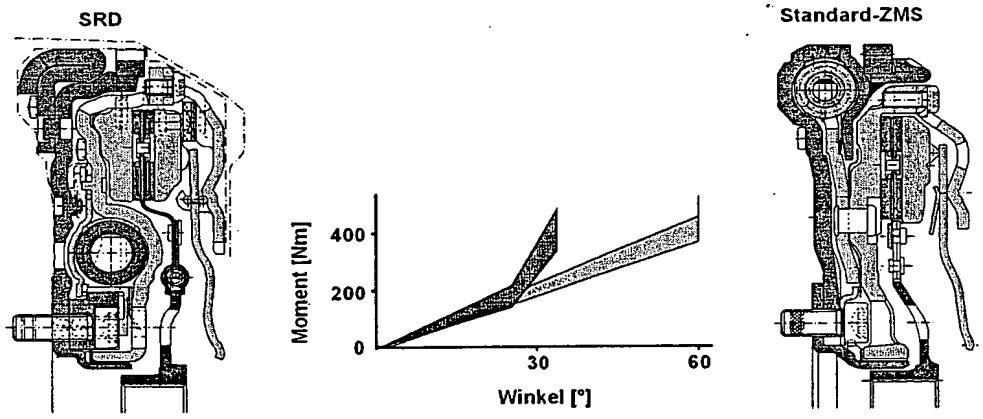
12. Kraftfahrzeug mit einer Pumpe, wie Flügelzellenpumpe oder G-Rotor-Pumpe oder Rollenzellenpumpe, insbesondere zur Schmierölversorgung eines Verbrennungsmotors, wobei der Volumenstrom der Pumpe temperaturabhängig beeinflussbar ist.

13. Kraftfahrzeug mit einer Klimaanlage mit Klimakompressor, wie Schwenkringkompressor, insbesondere zur Verwendung von CO_2 als Kältemittel, wobei die Klimaanlage zur Kühlung und/oder Erwärmung durch Verwendung als Wärmepumpe einsetzbar ist.

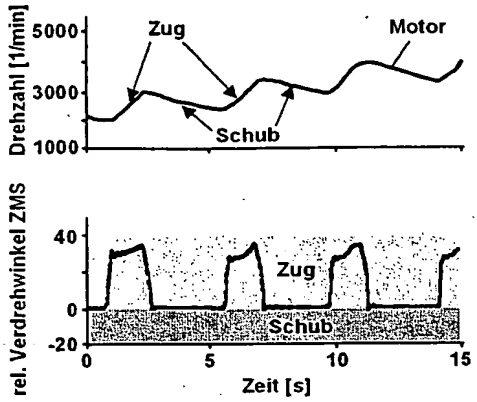
14. Kraftfahrzeug mit einem Getriebe, insbesondere automatisiertes Schaltgetriebe, wobei verschiedene Schalt- und Kupplungsstrategien hydraulisch und/oder elektromotorisch ausgeführt werden können.



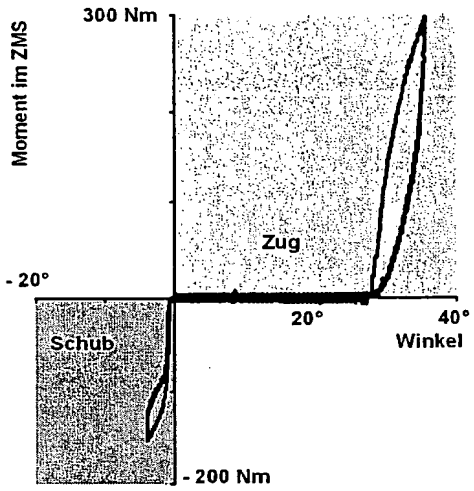
Figur 1



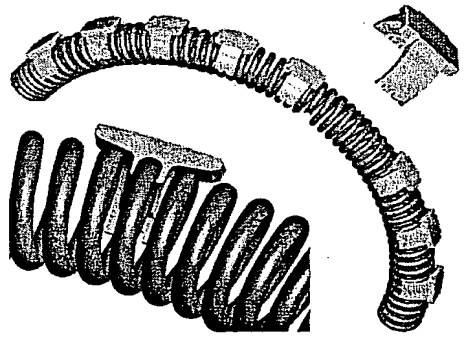
Figur 2



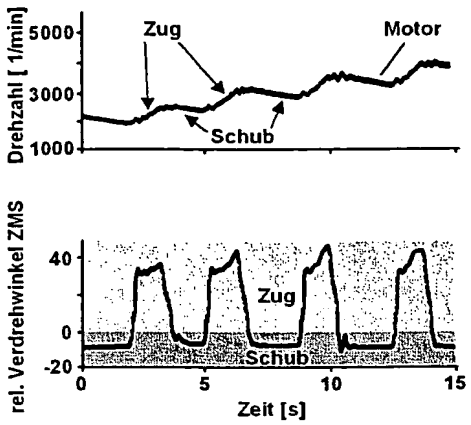
Figur 3



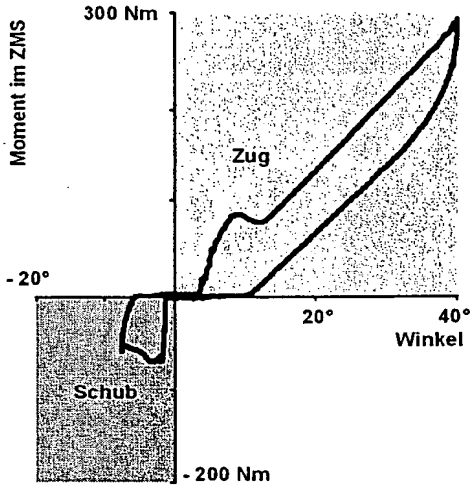
Figur 4



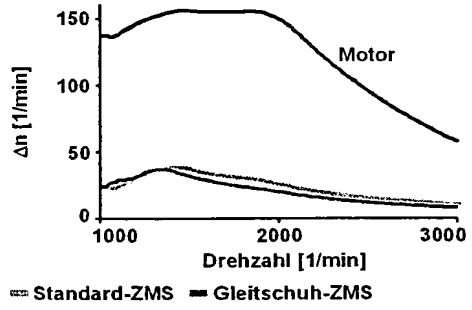
Figur 5



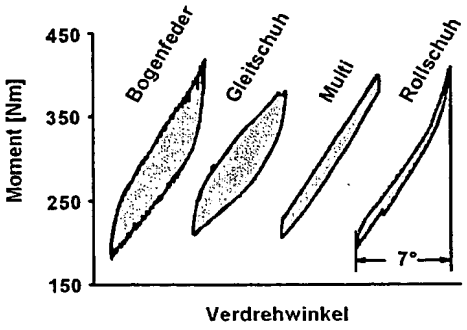
Figur 6



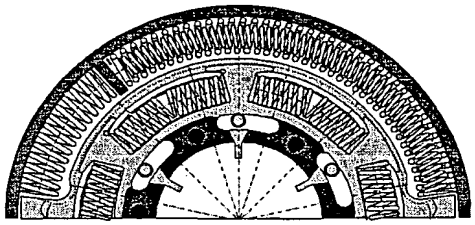
Figur 7



Figur 8



Figur 9

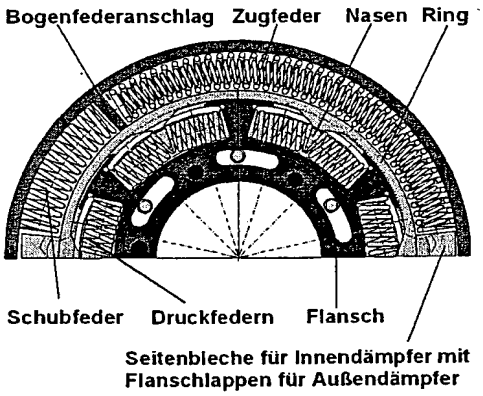


Außendämpfer:

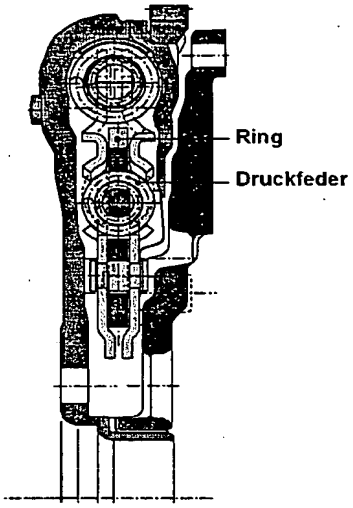
- **keine vorgespannte Bogenfeder**
- **$M_{Anschlag} < M_{Motor}$**

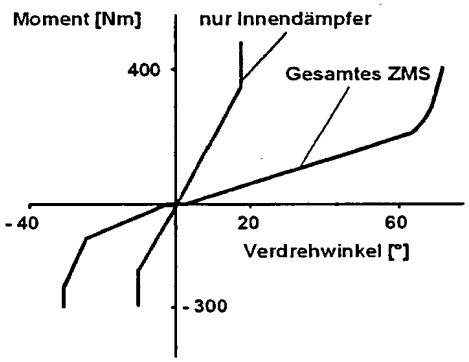
Innendämpfer:

- **reibungsfrei**
- **Serienschaltung 2er Druckfedern**
- **$M_{Anschlag} < M_{Motor}$**

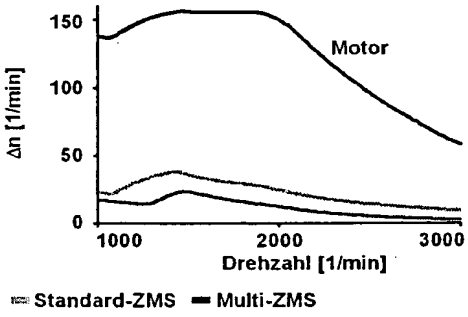


Figur 10

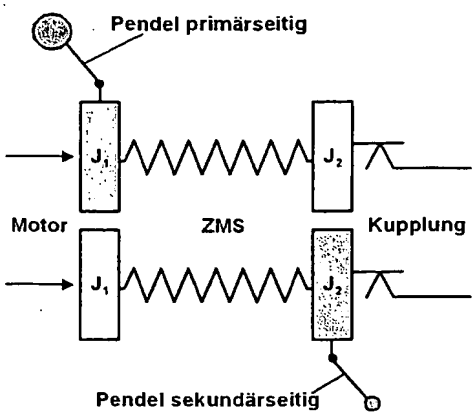




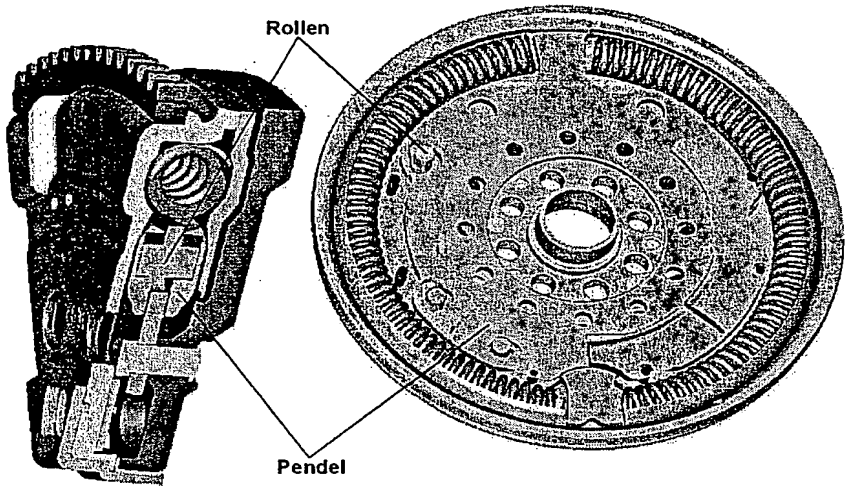
Figur 11



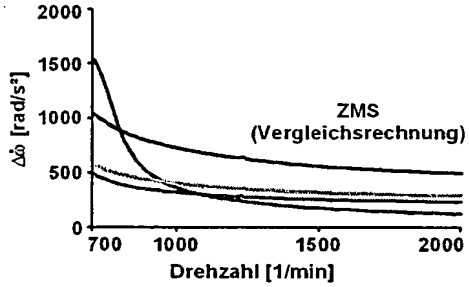
Figur 12



Figur 13

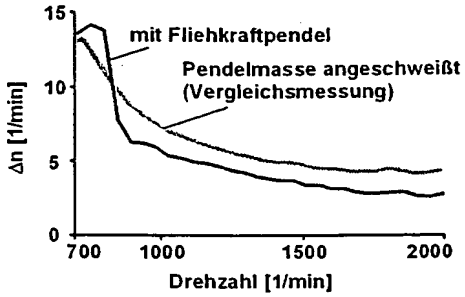


Figur 14

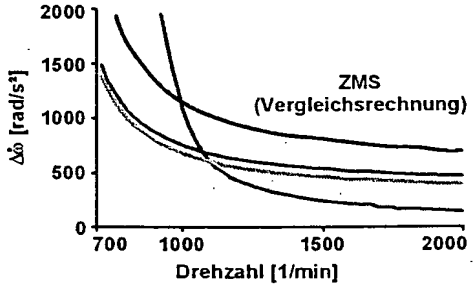


Eigenfrequenz abgestimmt auf:
3. Ordnung 3,1. Ordnung 3,2. Ordnung

Figur 15



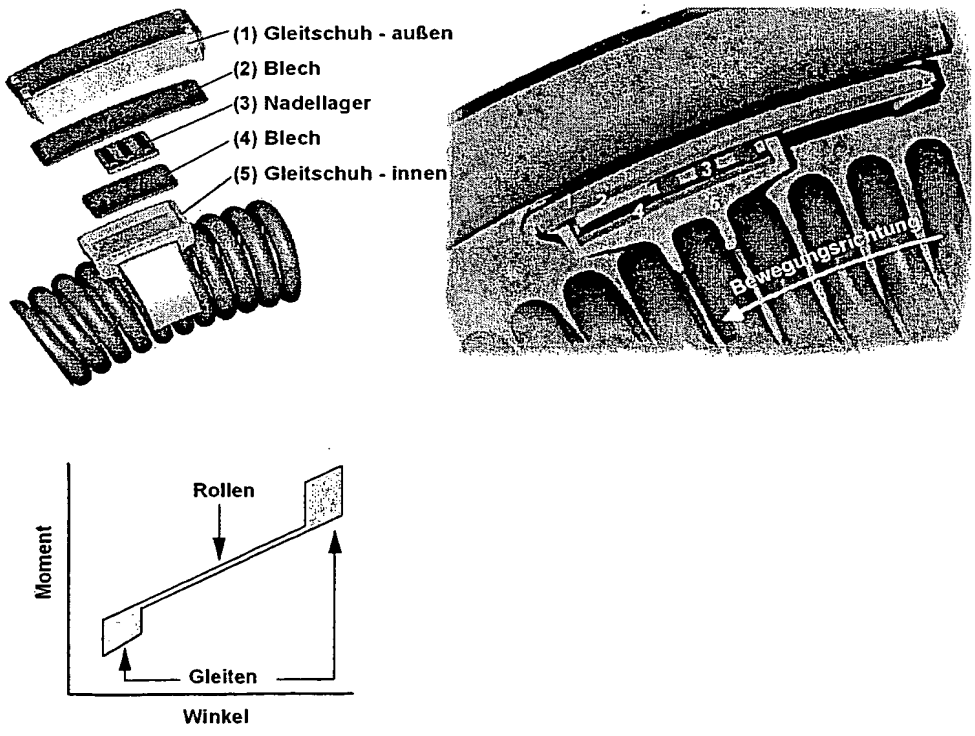
Figur 16



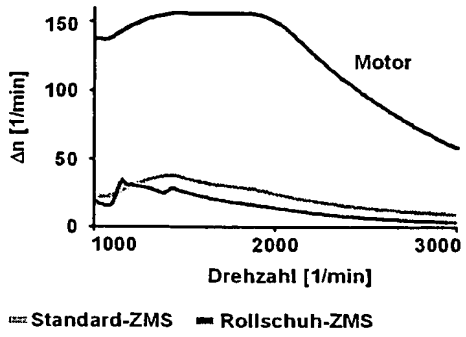
Eigenfrequenz abgestimmt auf:

2. Ordnung 2,2. Ordnung 2,5. Ordnung

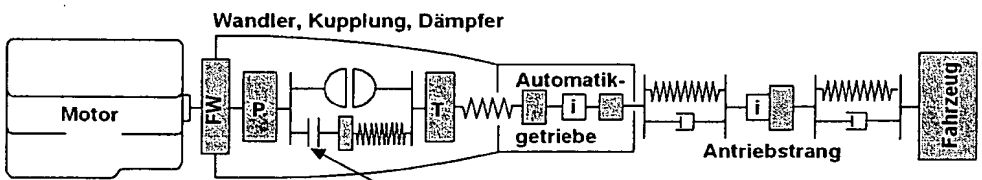
Figur 17

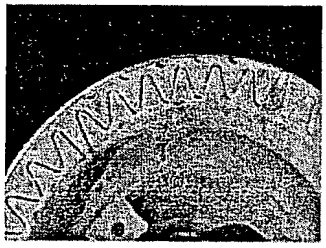


Figur 18

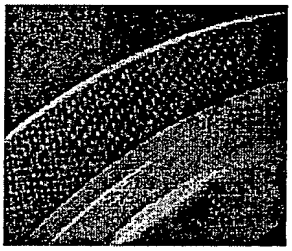


Figur 19





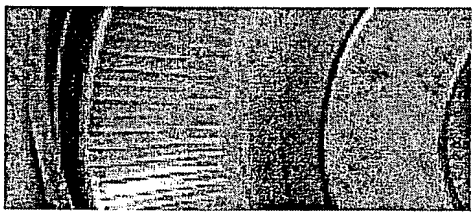
Zick-Zack-Nuten im Papierbelag



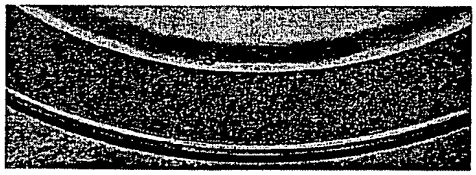
Poröser Carbonfaserbelag

Figur 20

Genuteter Deckel

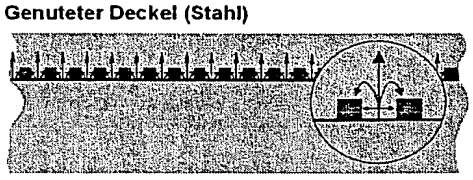


Ungenuteter Reibbelag



Figur 21

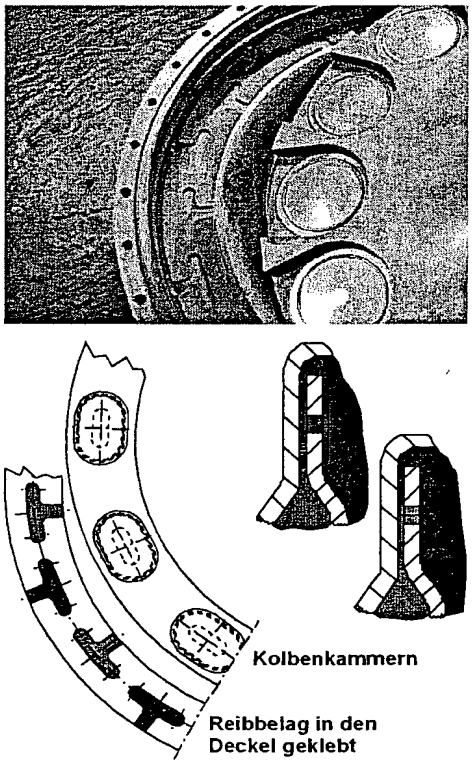
Wärmeübergang in den Deckel und dann in das Öl der sich vorbeibewegenden Nuten



Mehr Nuten bedeutet besserer Wärmeübergang bei gleichbleibender Durchflußrate

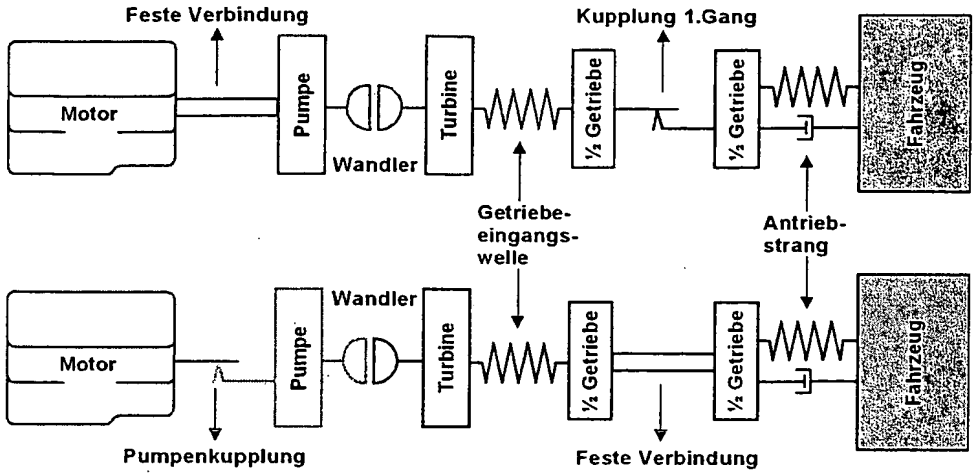
■ Ölnuten ▒ Reibbelag (Wärmeisolator)

Figur 22



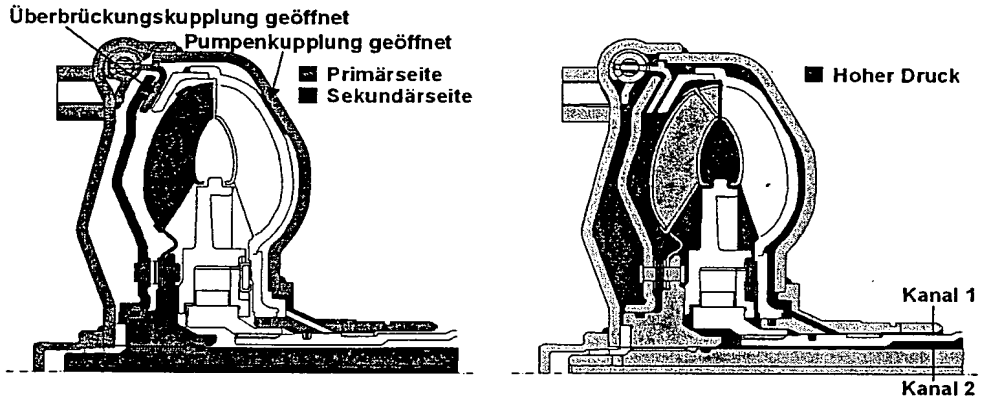
Figur 23

Schaltvorgang von Leerlauf nach "D"

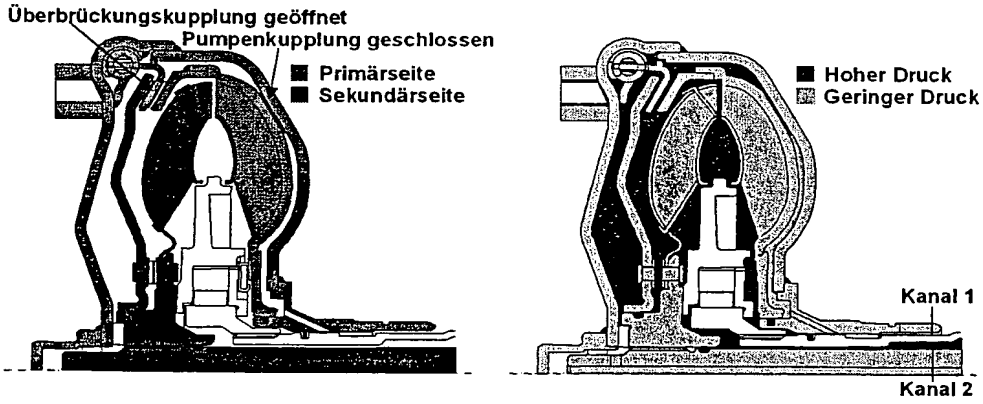


Betätigung der Kupplung zwischen Deckel und Pumpe

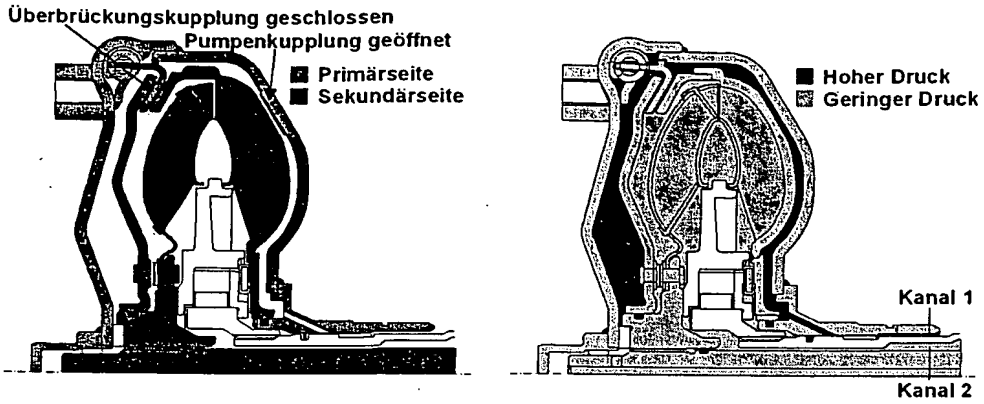
Figur 24



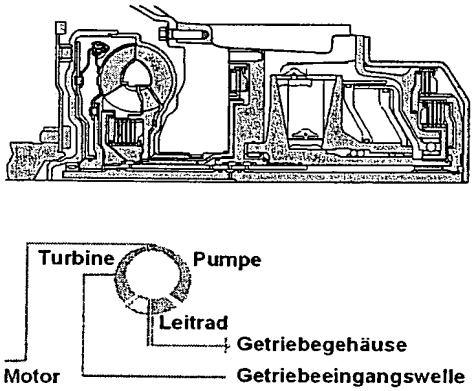
Figur 25



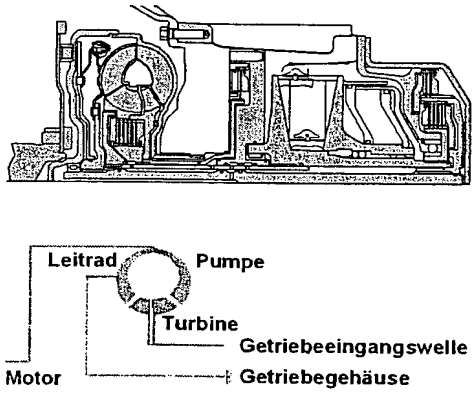
Figur 26



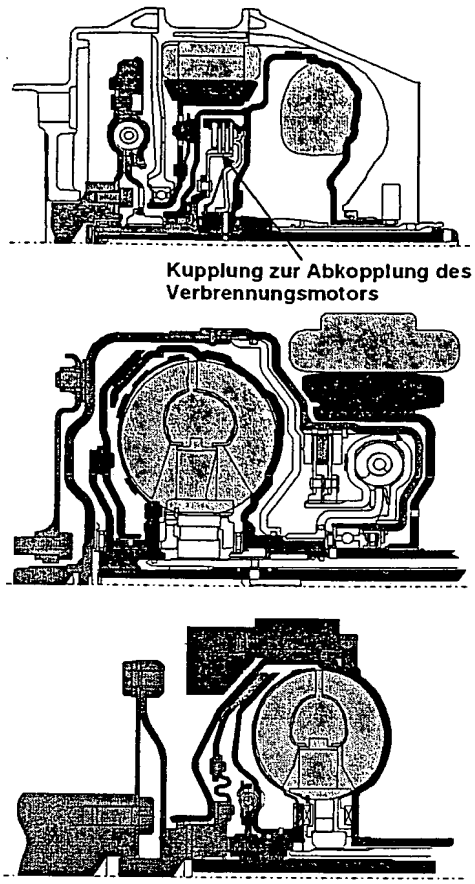
Figur 27



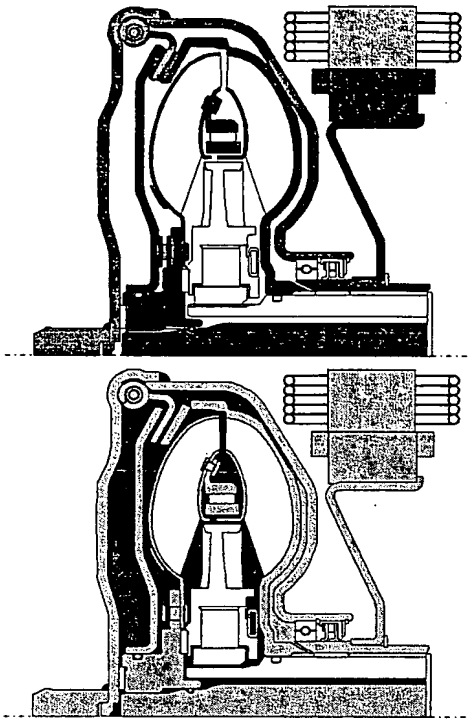
Figur 28



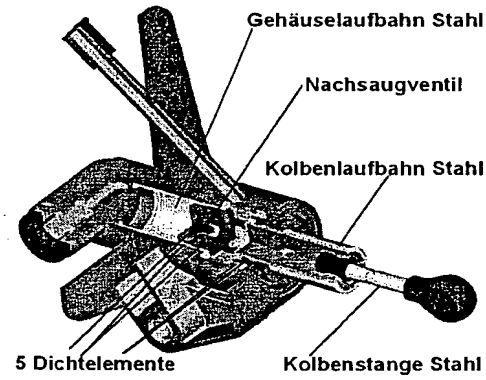
Figur 29


Kupplung zur Abkopplung des Verbrennungsmotors
E-Maschine
Wandler

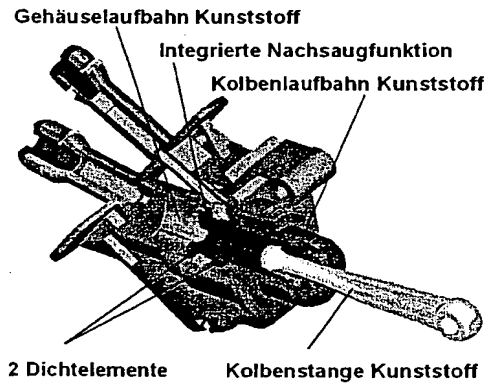
Figur 30



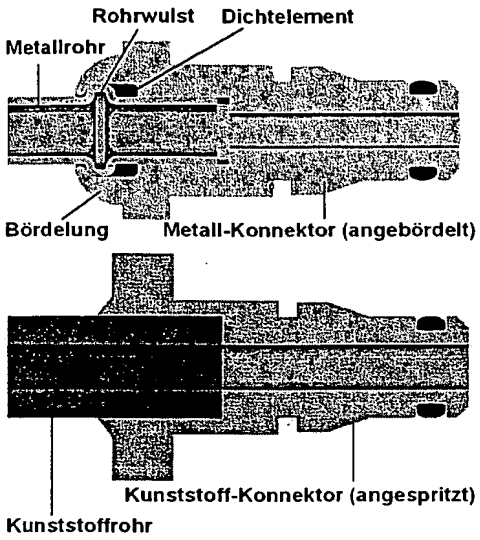
Figur 31



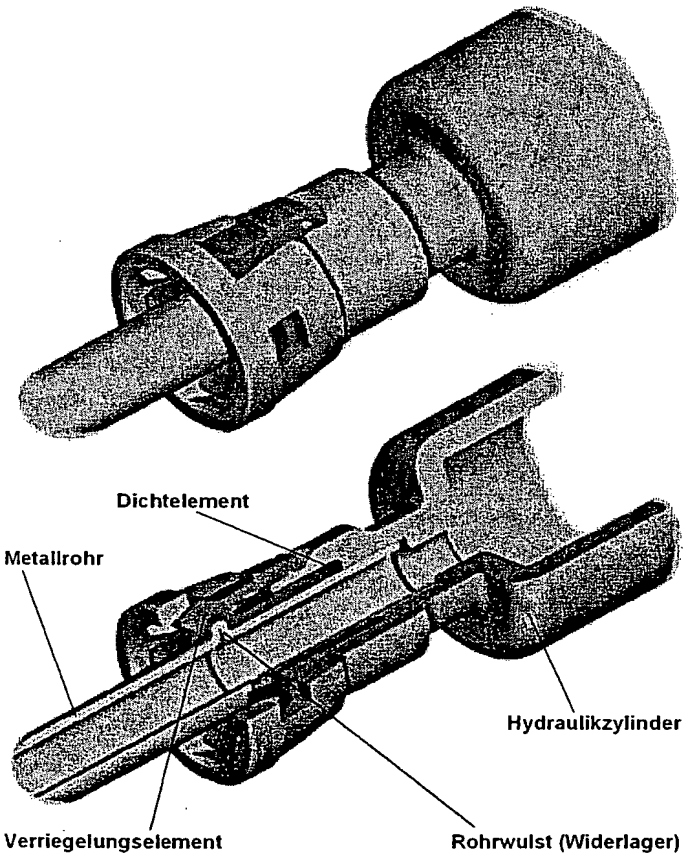
Figur 32



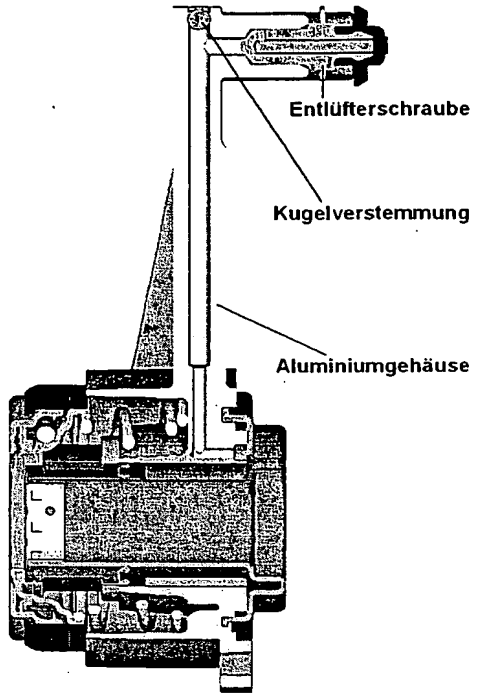
Figur 33



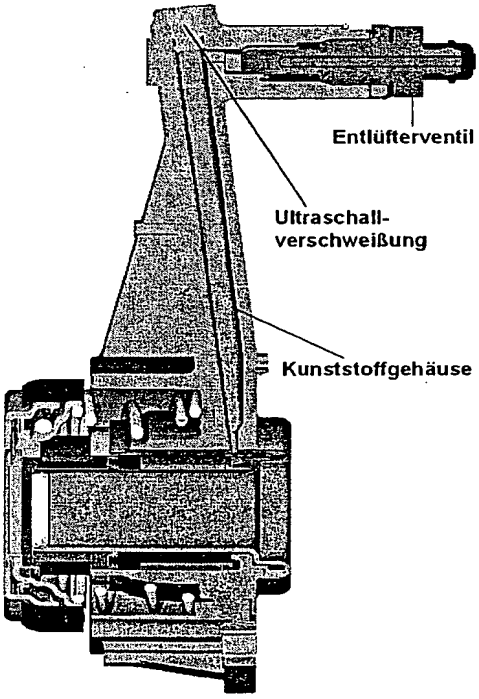
Figur 34



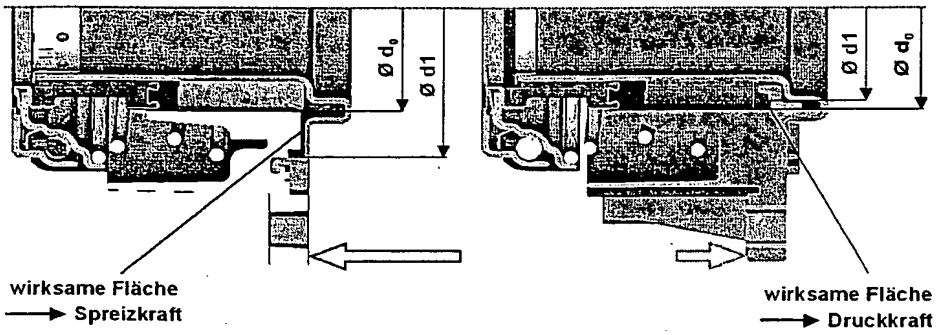
Figur 35



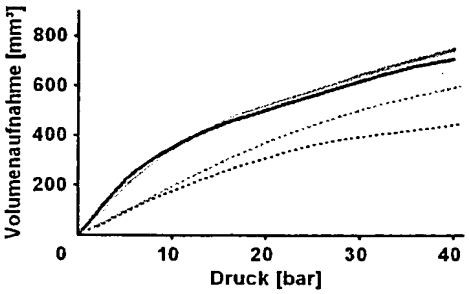
Figur 36



Figur 37



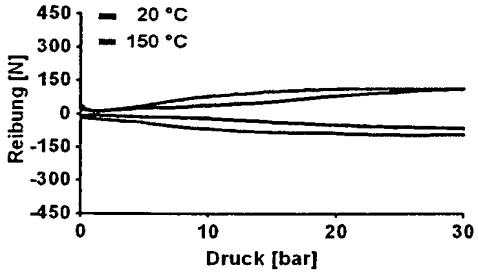
Figur 38



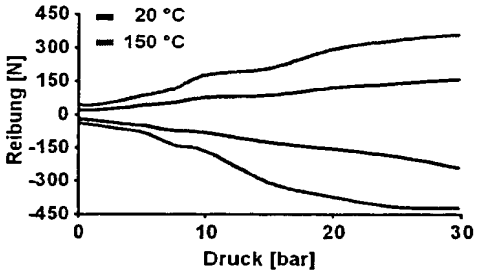
Kunststoff - CSC +80 °C
Kunststoff - CSC -40 °C
Aluminium - CSC +80 °C
Aluminium - CSC -40 °C

Figur 39

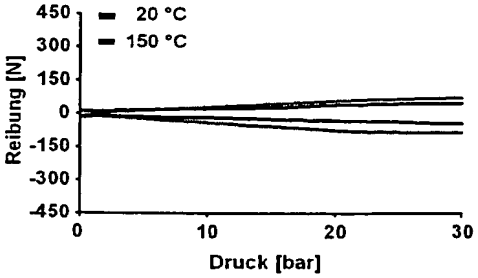
Aluminium - CSC Neuzustand



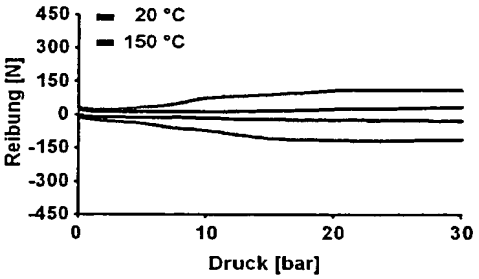
Aluminium - CSC nach Laufstrecke



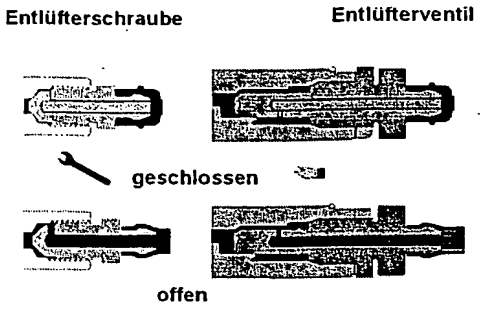
Kunststoff - CSC Neuzustand



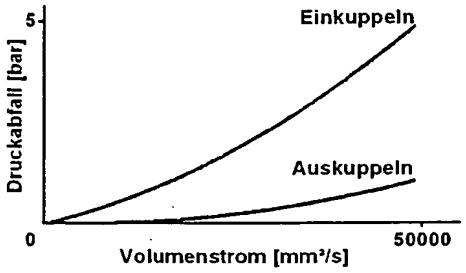
Kunststoff - CSC nach Laufstrecke

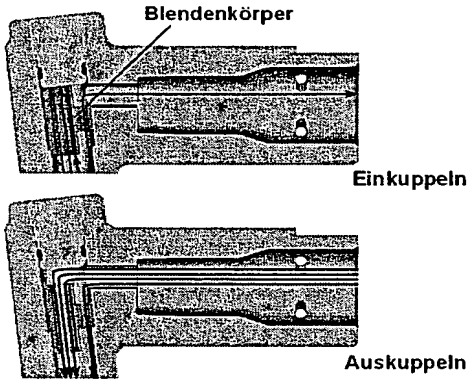


Figur 40

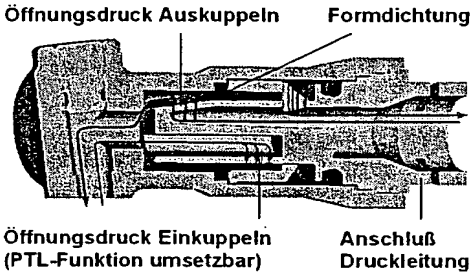


Figur 41

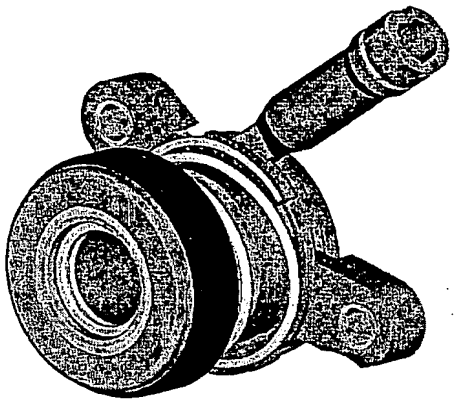




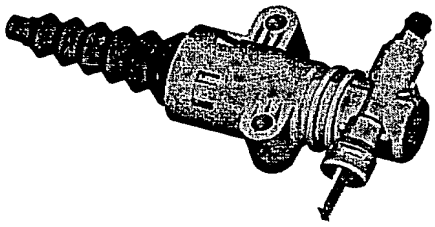
Figur 42



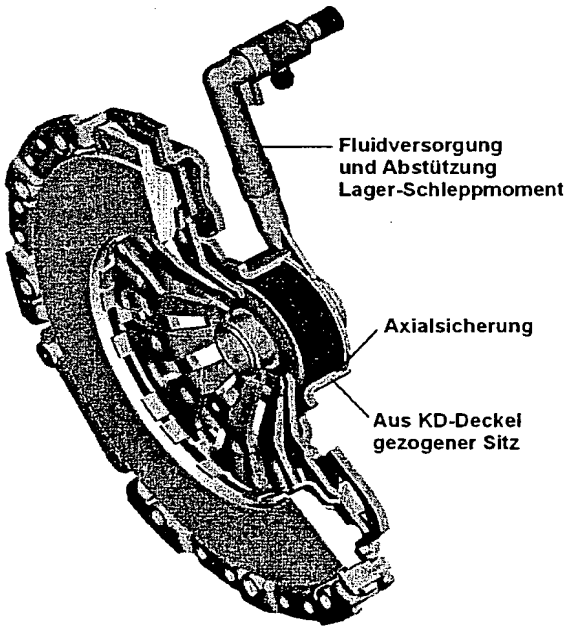
Figur 43



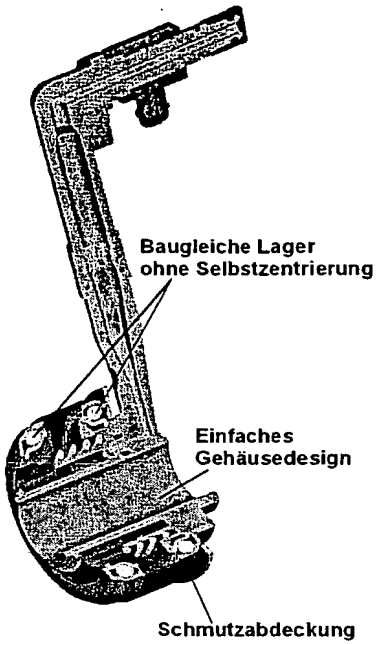
Figur 44



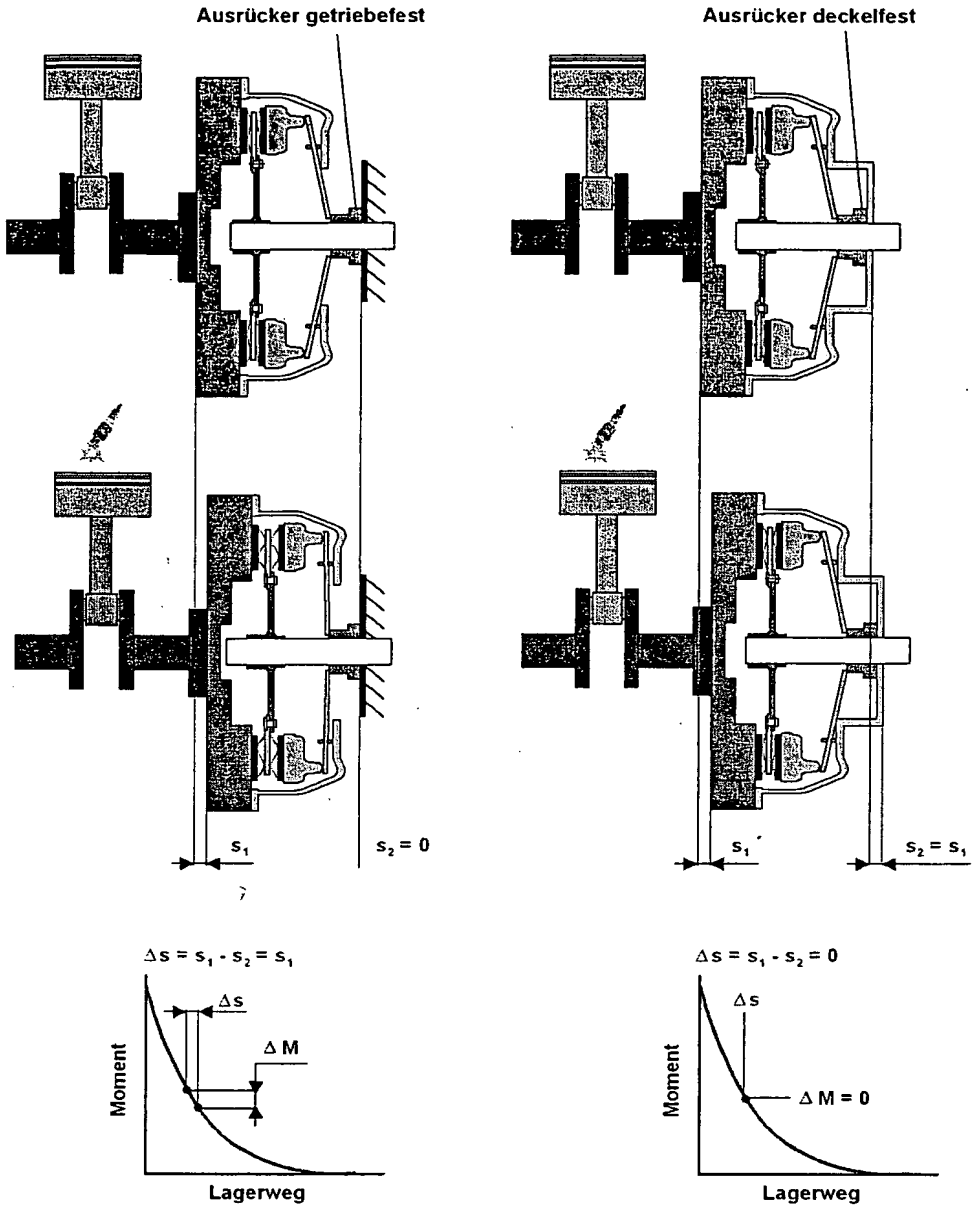
Figur 45



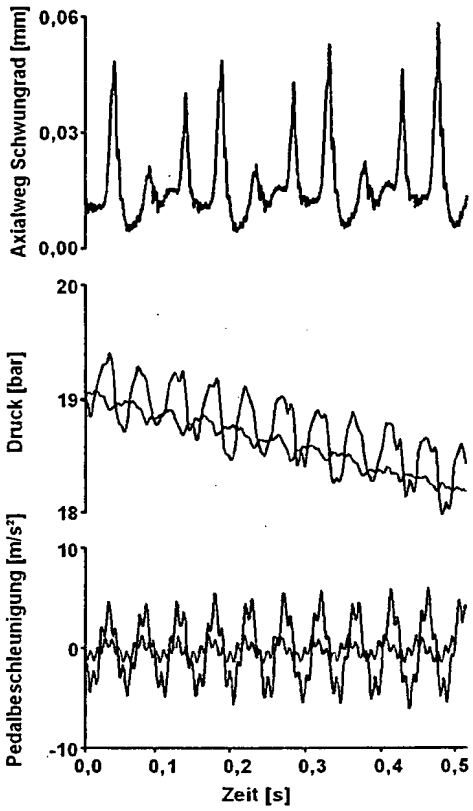
Figur 46


Baugleiche Lager
ohne Selbstzentrierung
Einfaches
Gehäusedesign
Schmutzabdeckung

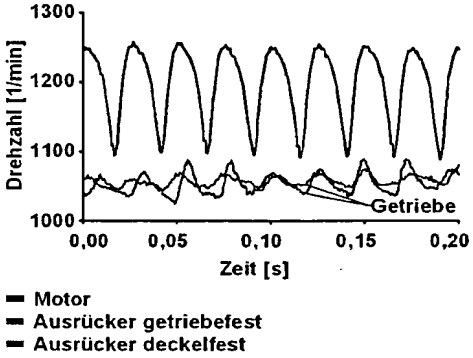
Figur 47


Ausrücker getriebefest
Ausrücker deckelfest
s1
s2 = 0
s1
s2 = s1
Δs = s1 - s2 = s1
Δs
ΔM
Moment
Lagerweg
Δs = s1 - s2 = 0
Δs
ΔM = 0
Moment
Lagerweg

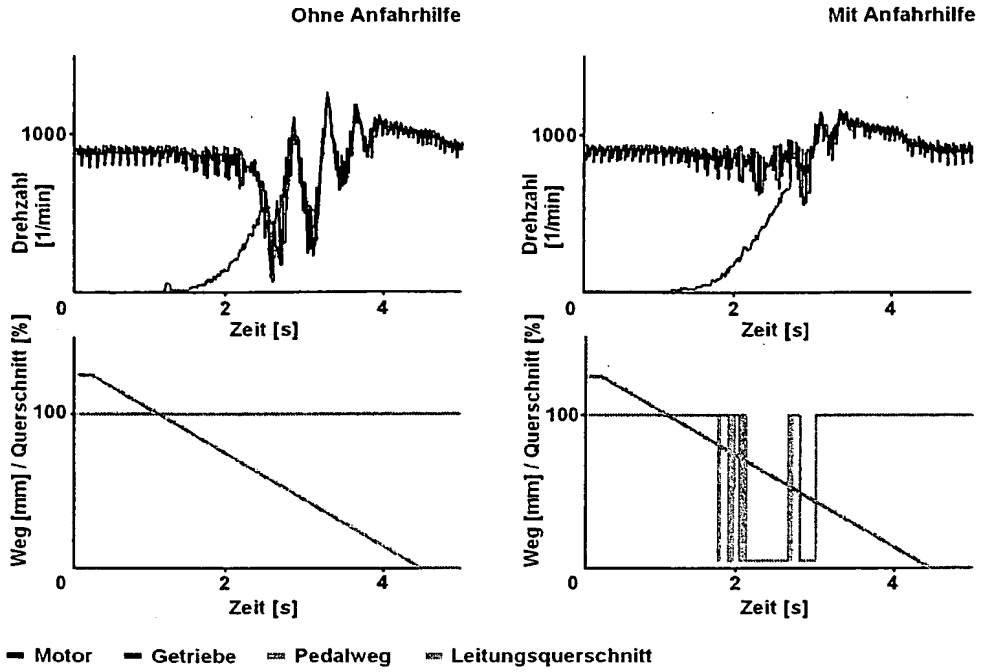
Figur 48



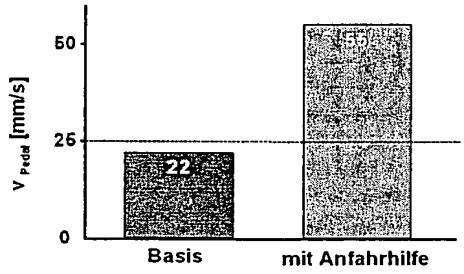
Figur 49



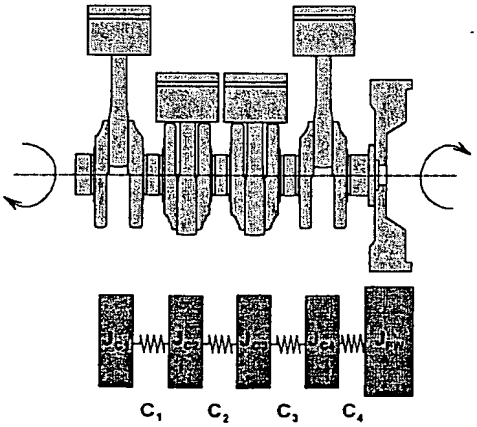
Figur 50



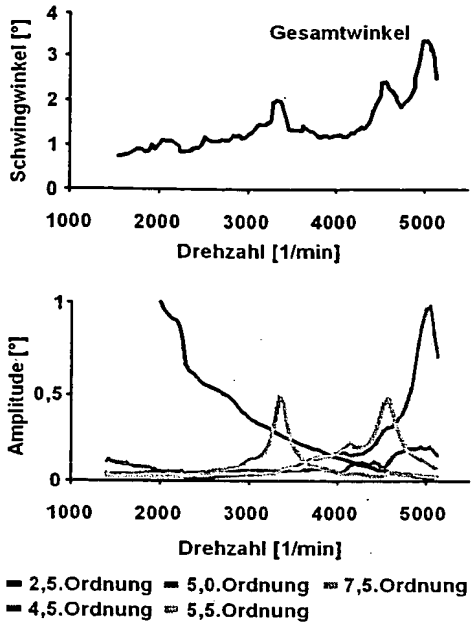
Figur 51



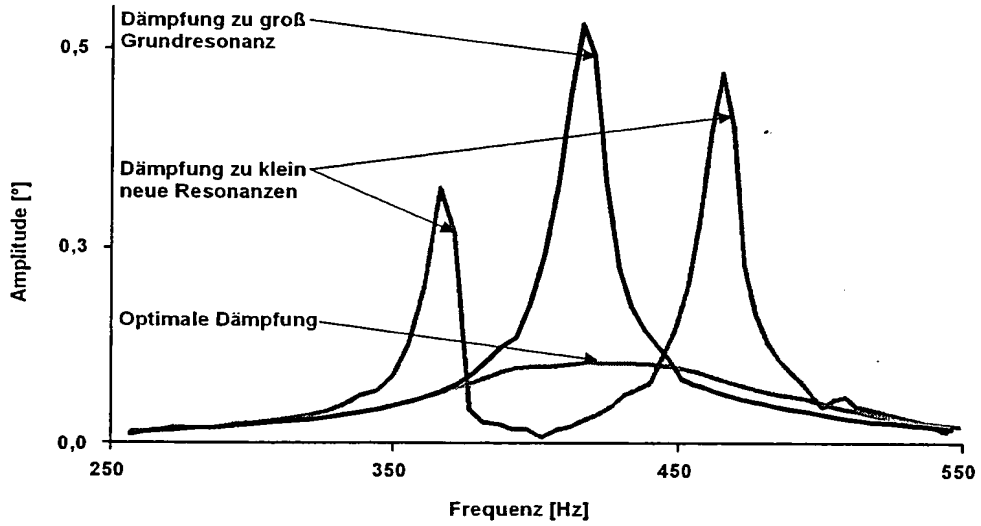
Figur 52



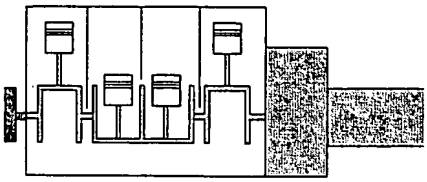
Figur 53



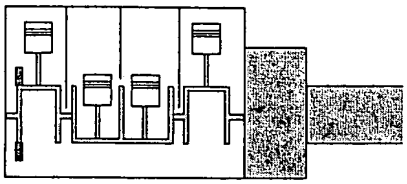
Figur 54



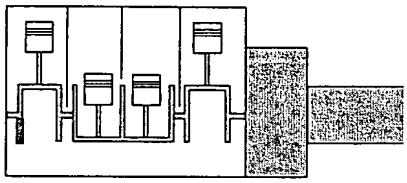
Figur 55



aussenliegender Dämpfer

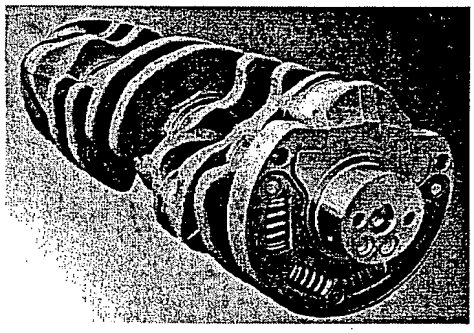


interner Dämpfer deutsches Patent 536 929

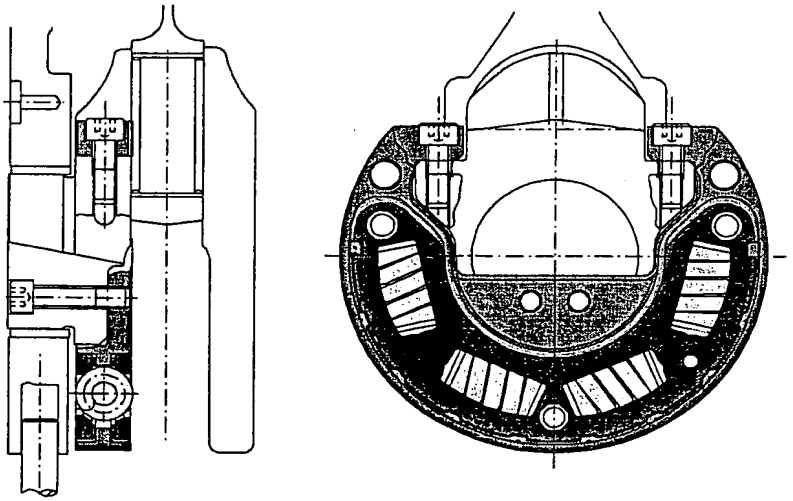


interner Dämpfer ICD

Figur 56

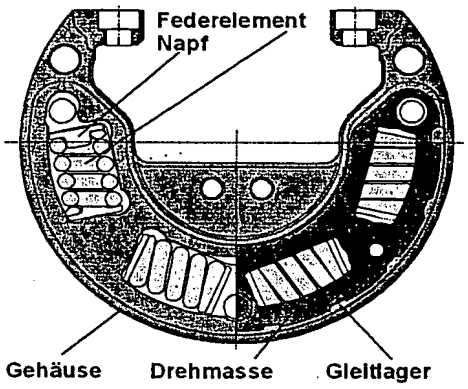


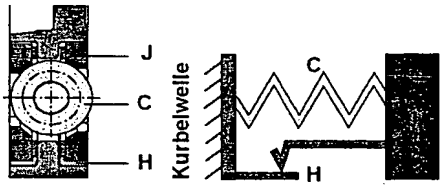
Figur 57



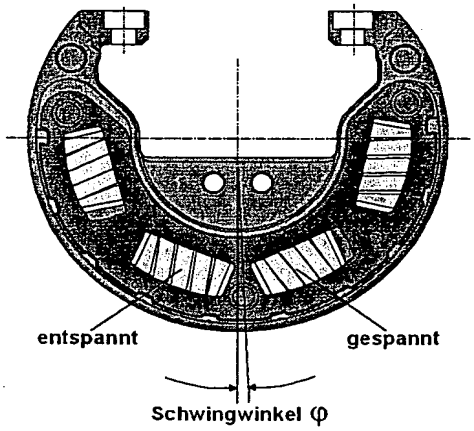
Figur 58

H = f(n) ; C = const ; J = const .

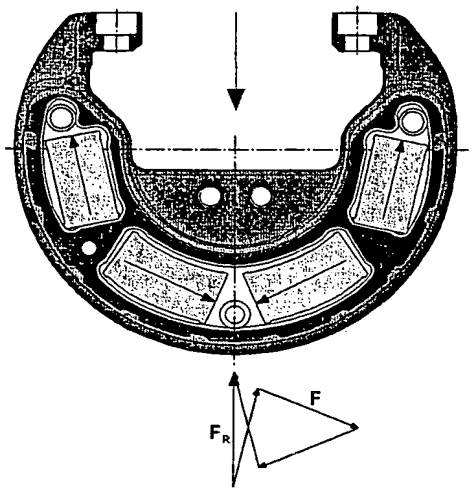




Figur 59



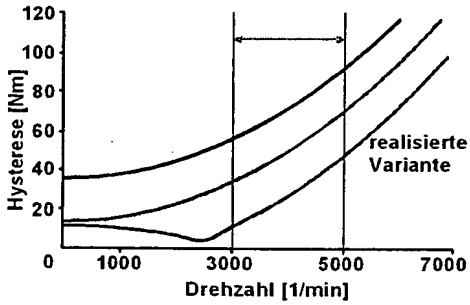
Figur 60



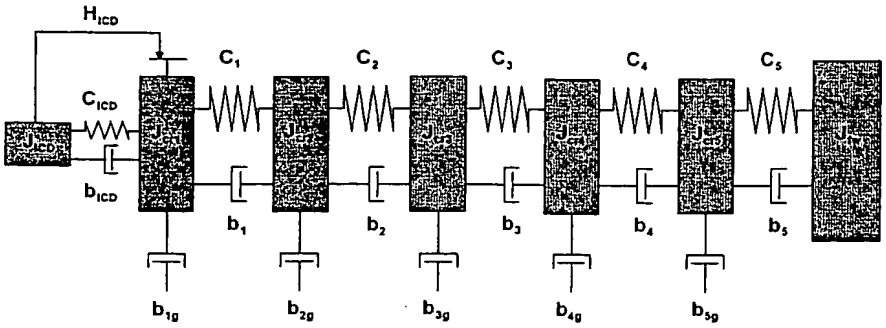
F = Federvorspannung
F_R = Resultierende der Federvorspannung
= Fliehkraft

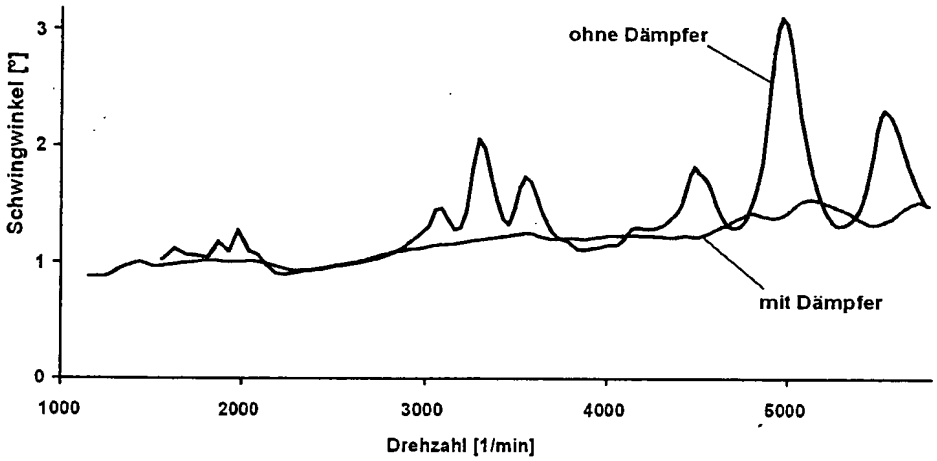
Figur 61

Hauptarbeitsbereich

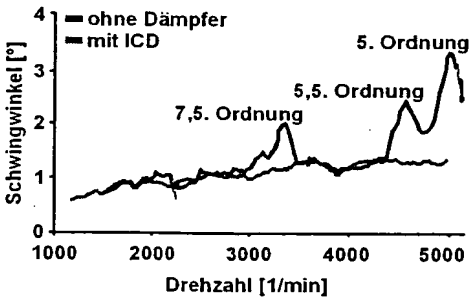


Figur 62

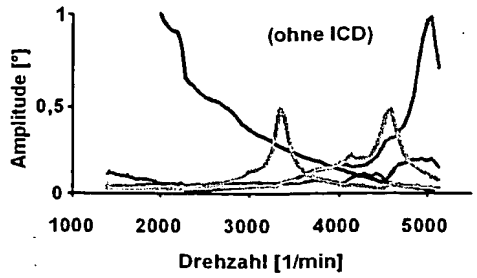


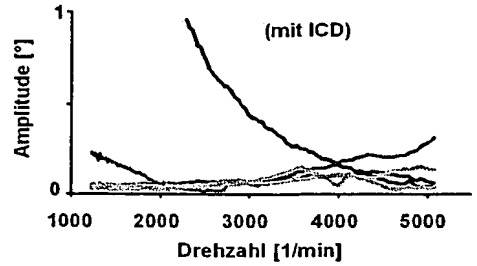


Figur 63



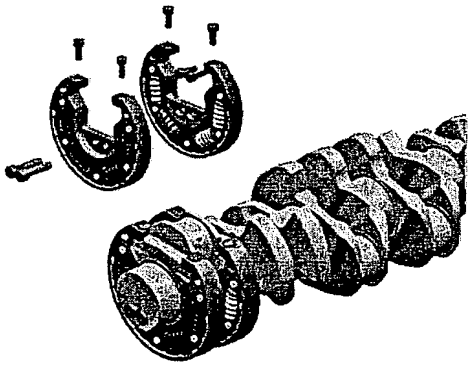
Figur 64



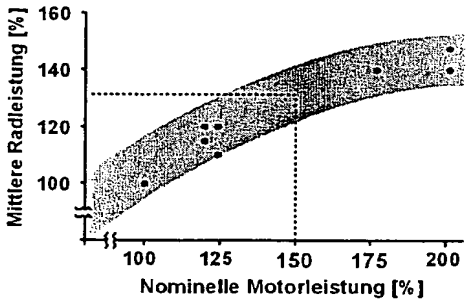


2,5.Ordnung 5,0.Ordnung 7,5.Ordnung
4,5.Ordnung 5,5.Ordnung

Figur 65

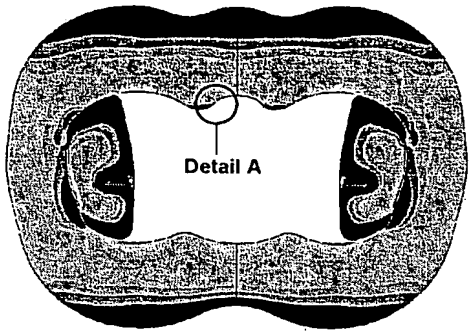


Figur 66

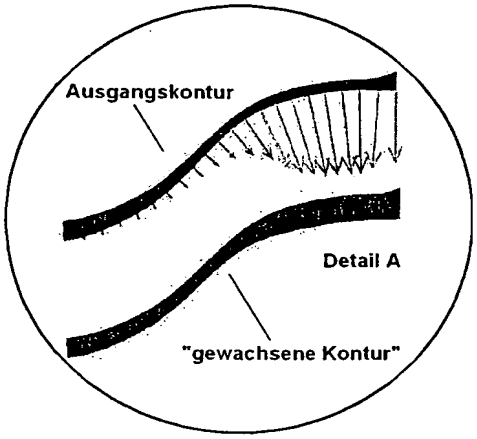


- Kundenkollektive

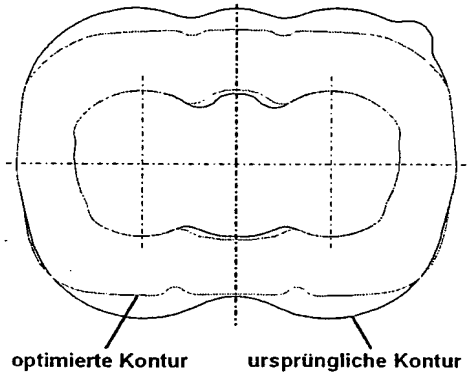
Figur 67



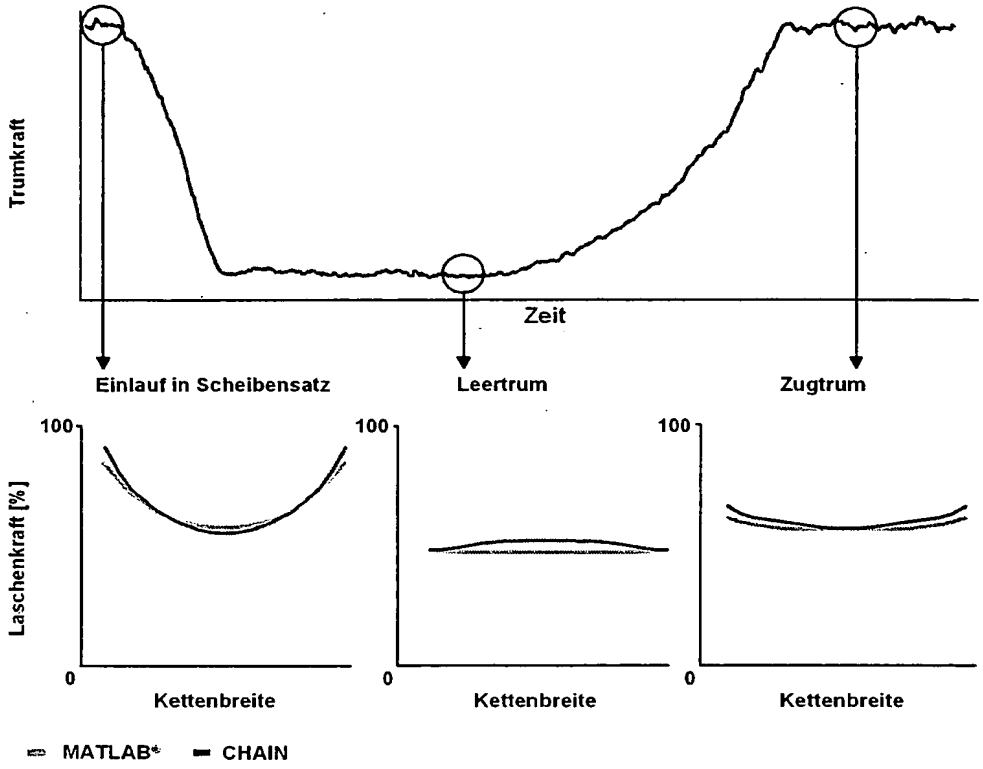
Figur 68



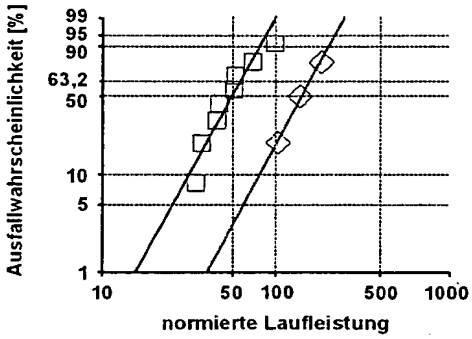
Figur 69



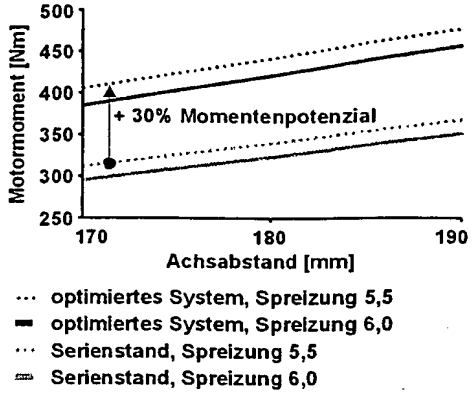
Figur 70



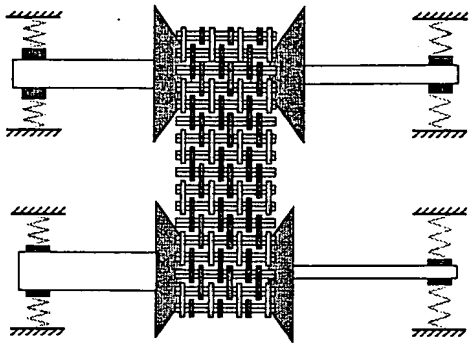
Figur 71



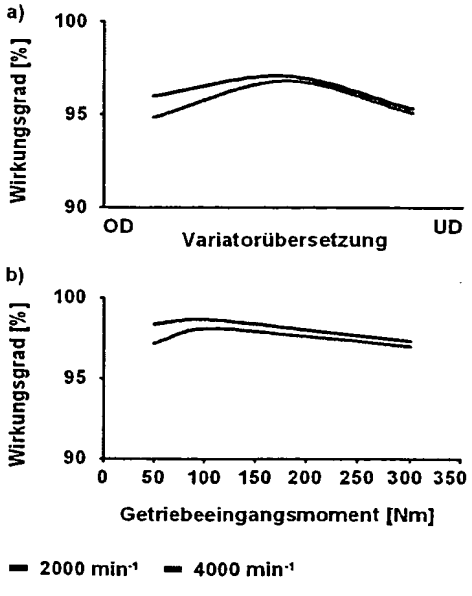
Figur 72



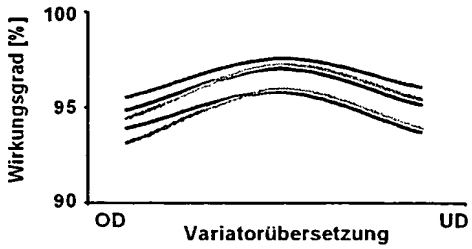
Figur 73



Figur 74



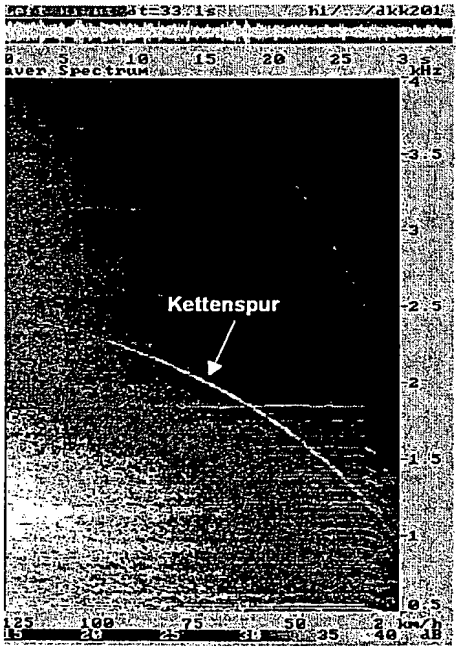
Figur 75



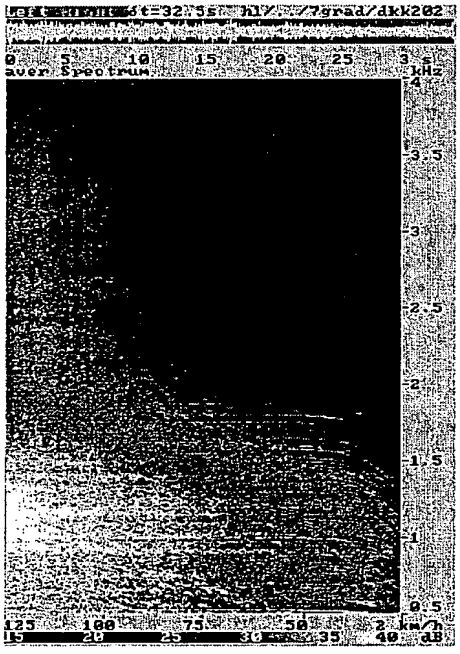
Variante		Scheibensatz-geometrie	Kette	Bemerkung
▬	Basis A	ge-wölbt	37 mm	Serie multi-tronic®
▭	B	11°	37 mm	-
▬	C	7°	37 mm	-
▬	D	ge-wölbt	37 mm „Leicht“	Welle: Ø + 2 mm
▭	E	ge-wölbt	37 mm	30% Über-anpressung

Figur 76

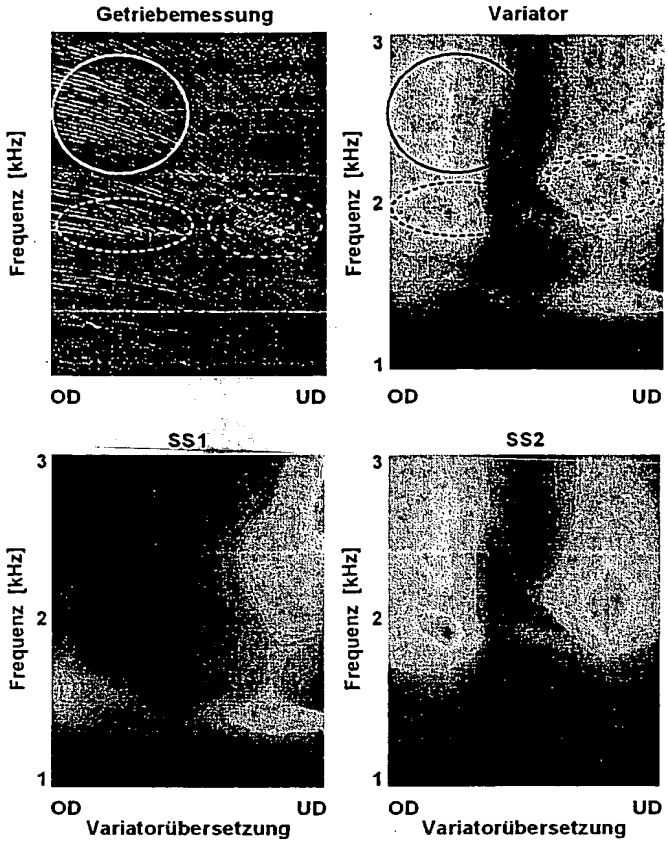
Gleichteilungskette



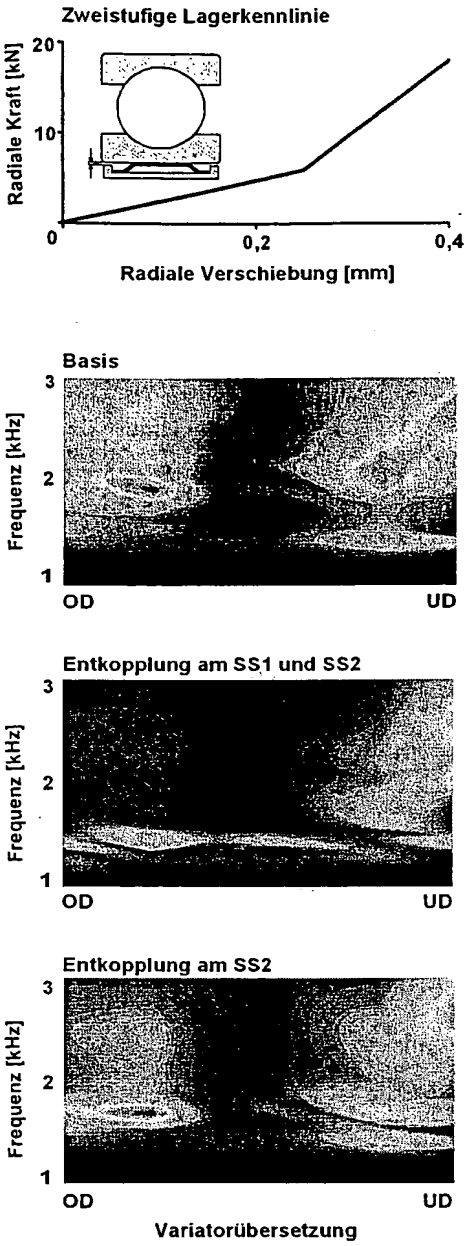
Random-Kette



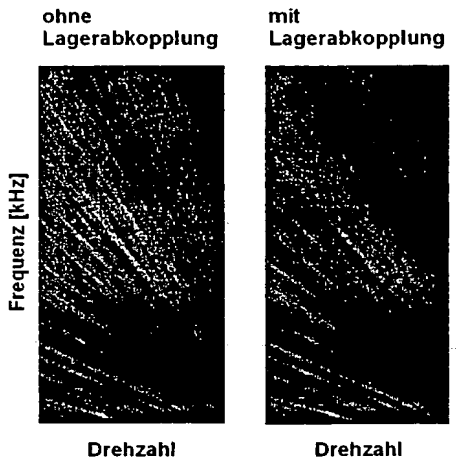
Figur 77


Getriebemessung
Variator
Frequenz [kHz]
3
2
1
OD
UD
SS1
SS2
Variatorübersetzung

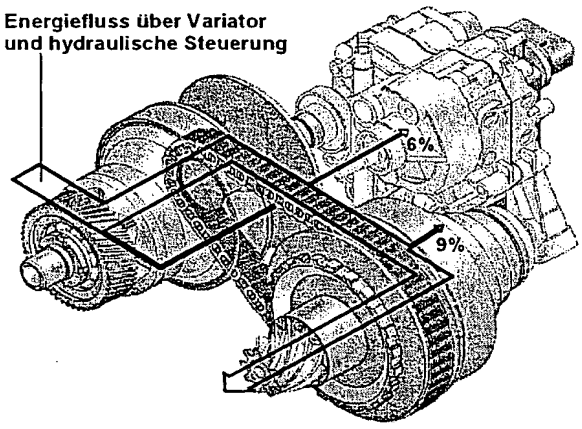
Figur 78

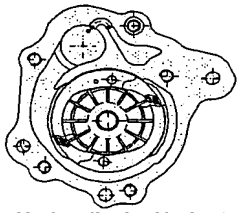

Zweistufige Lagerkennlinie
Radiale Kraft [kN]
20
10
0
0,2
0,4
Radiale Verschiebung [mm]
Basis
Frequenz [kHz]
3
2
1
OD
UD
Entkopplung am SS1 und SS2
Frequenz [kHz]
3
2
1
OD
UD
Entkopplung am SS2
Frequenz [kHz]
3
2
1
OD
UD
Variatorübersetzung

Figur 79

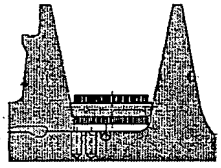


Figur 80





Hydraulische Verluste



Mechanische Verluste

Figur 81

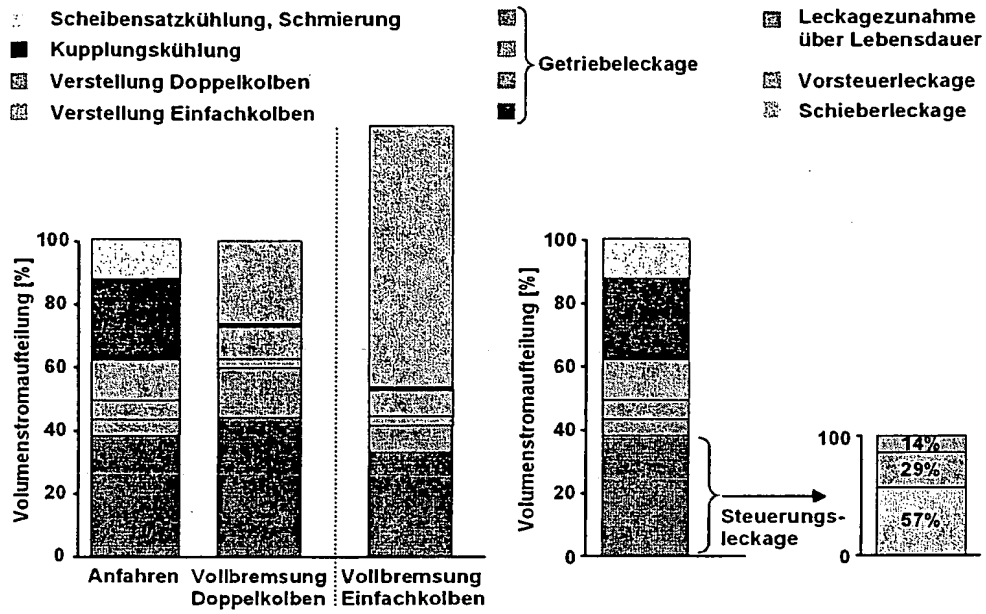
Geringe hydraulische Verluste =

Geringes Fördervolumen X **Geringer Pumpendruck**

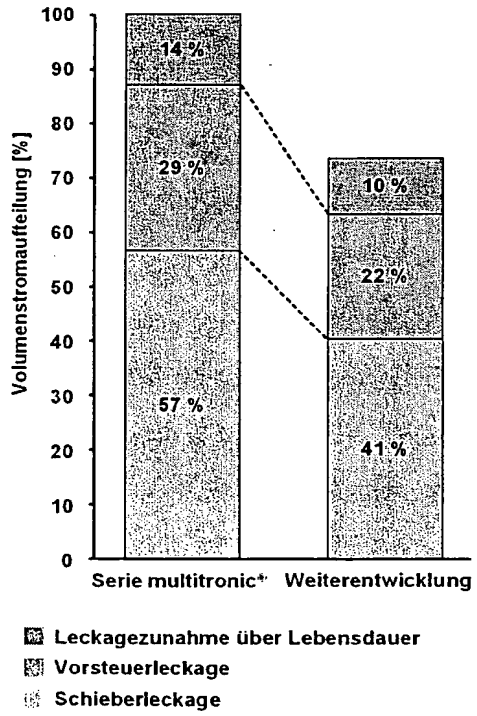
- **Scheibensätze mit LuK Doppelkolben**
- **Kupplungskühlung mit Saugstrahlpumpe**
- **Geringe Leckage**
  - **Pumpe mit axialer und radialer Spaltkompensation**
  - **geringe Schieberzahl**
  - **enge Spiele und kleine Fertigungstoleranzen**
  - **geringe Anzahl von E-Ventilen**

- **kleine Anpress-Sicherheitsfaktoren (Schlupfregelung)**
- **Systemdruck abhängig vom aktuellen Motormoment**
- **geringe Rückstaudrücke**

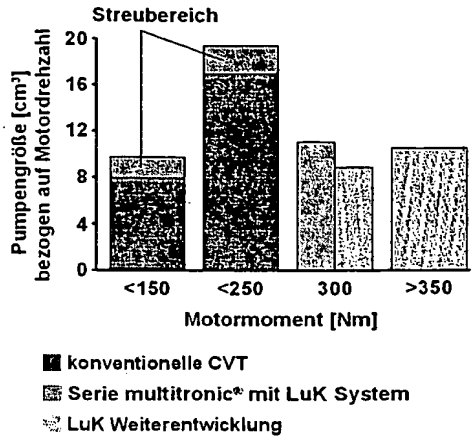
Figur 82



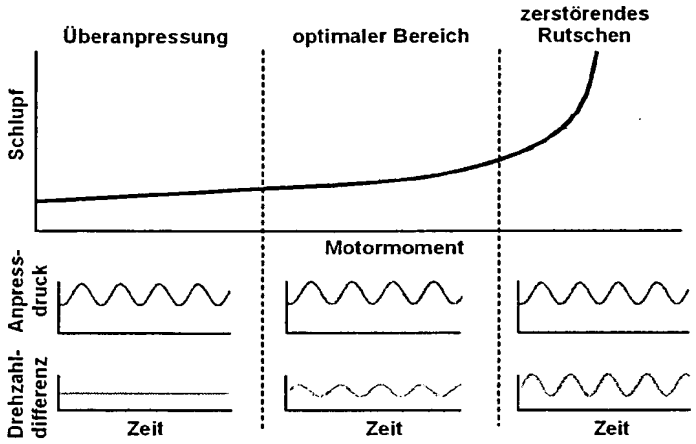
Figur 83



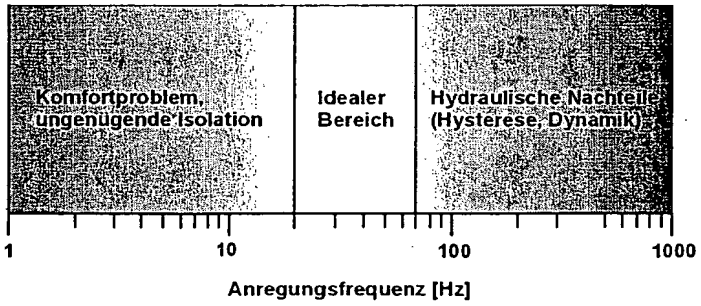
Figur 84



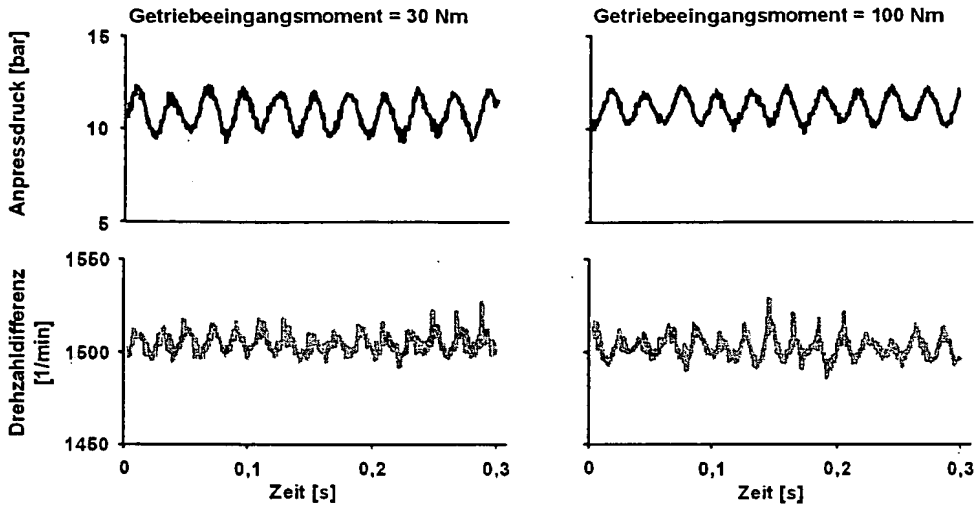
Figur 85



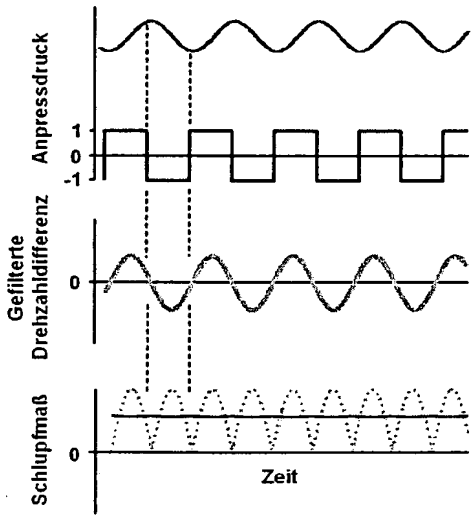
Figur 86



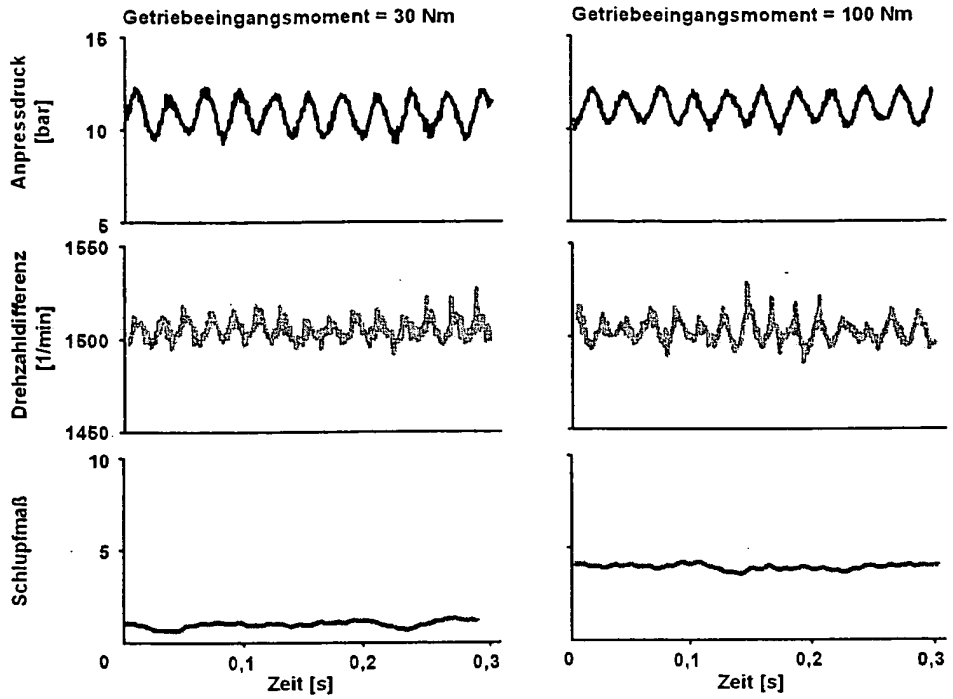
Figur 87



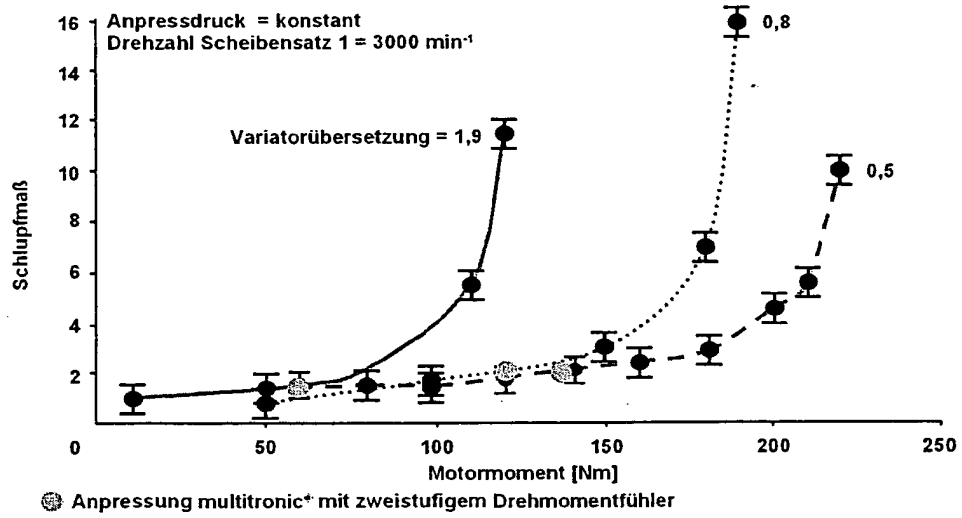
Figur 88



Figur 89

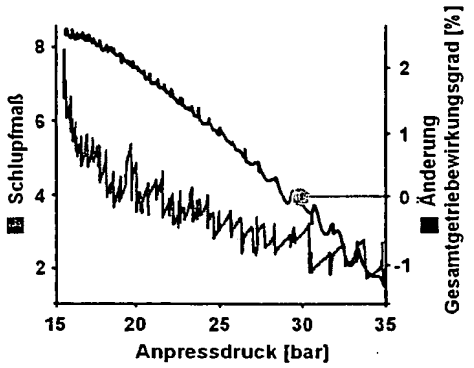


Figur 90



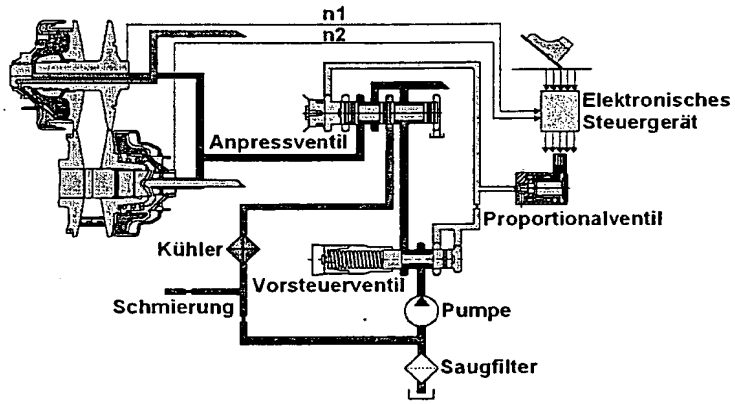
Figur 91

Variatorübersetzung = 0,47
Getriebeeingangsmoment = 310 Nm
Drehzahl Scheibensatz 1 = 2000 min^{-1}

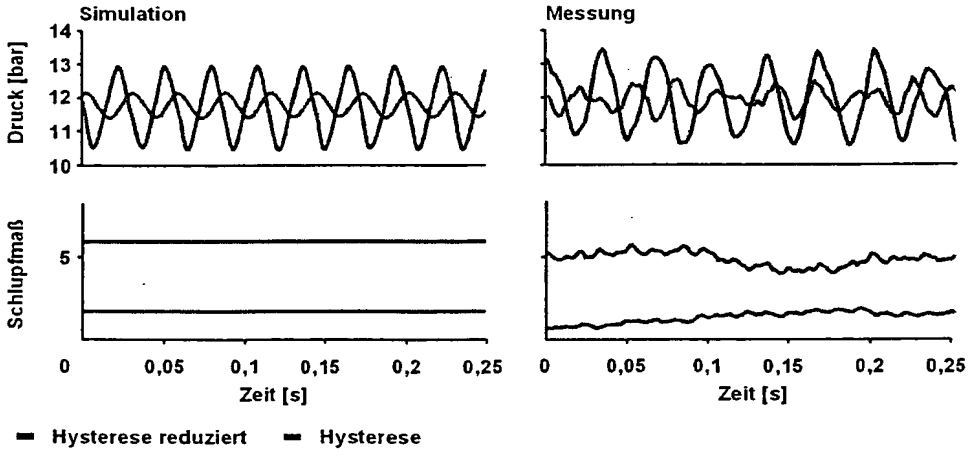


Anpressung multitronic®
mit zweistufigem Drehmomentfühler

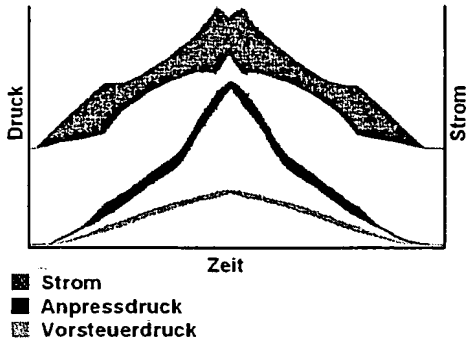
Figur 92



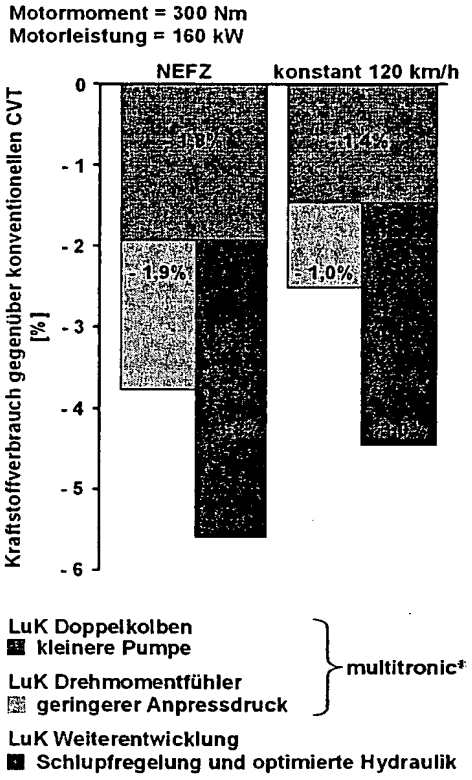
Figur 93



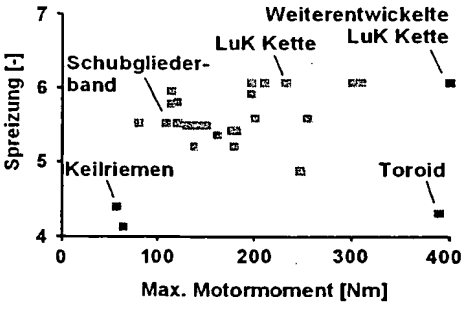
Figur 94



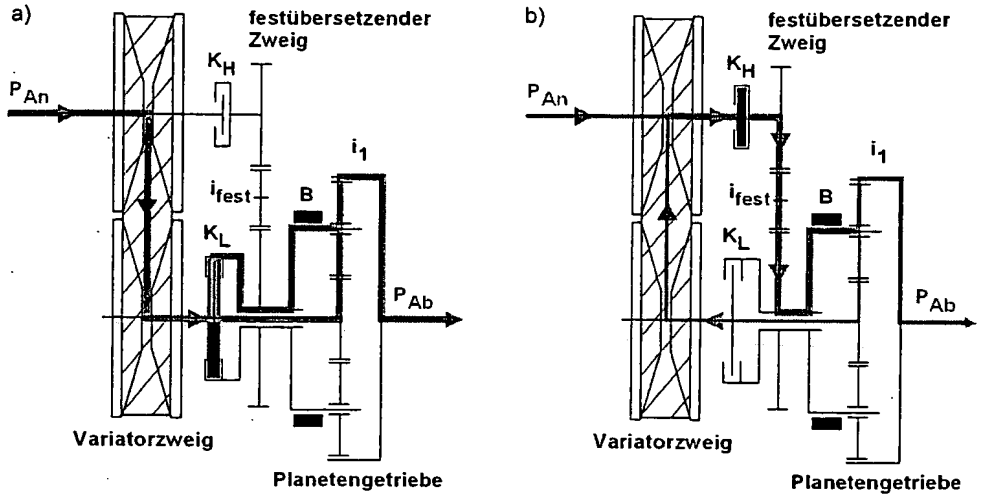
Figur 95



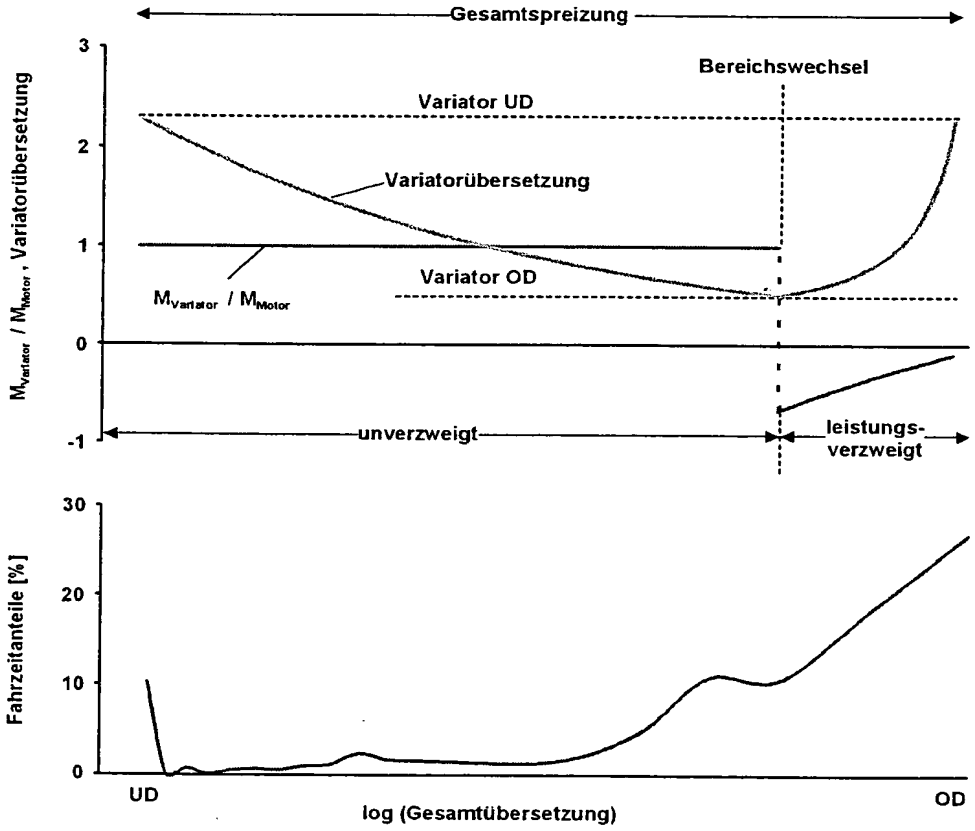
Figur 96



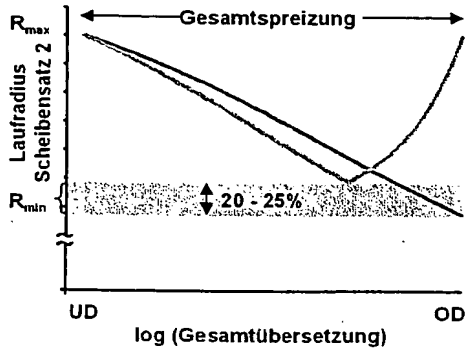
Figur 97



Figur 98



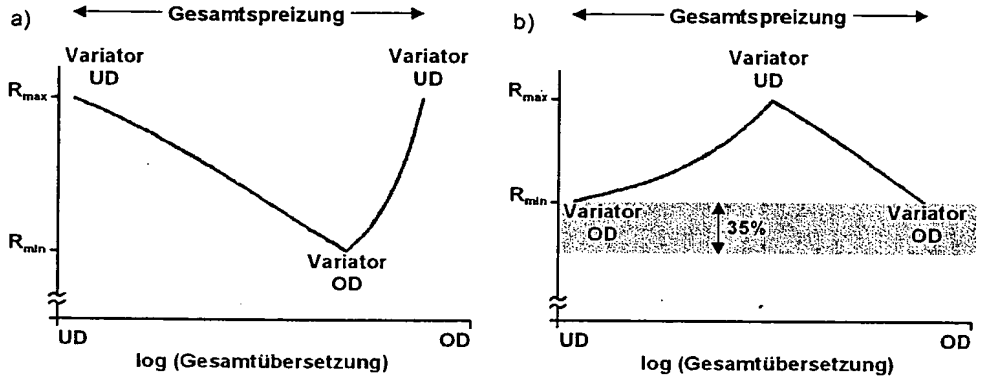
Figur 99



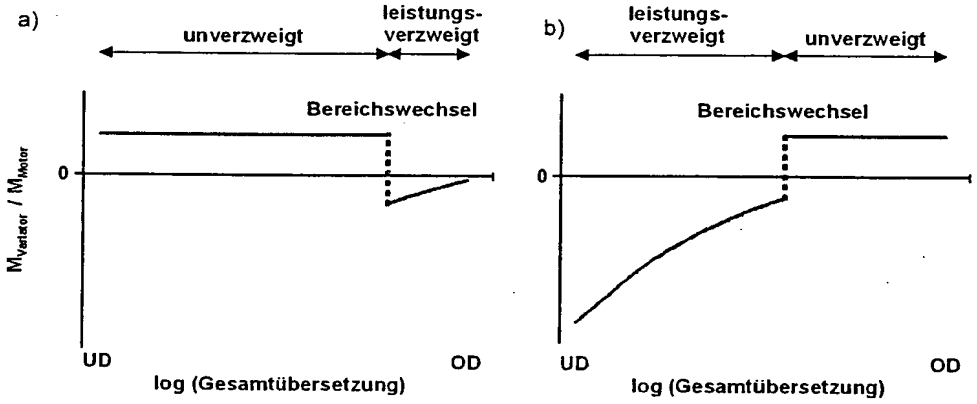
unverzweigter Triebstrang

Zweibereich-CVT

Figur 100

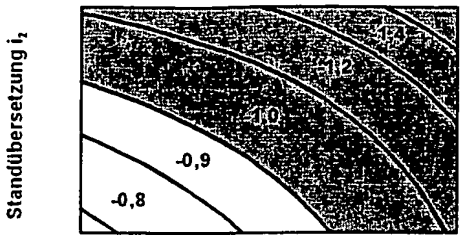


Figur 101

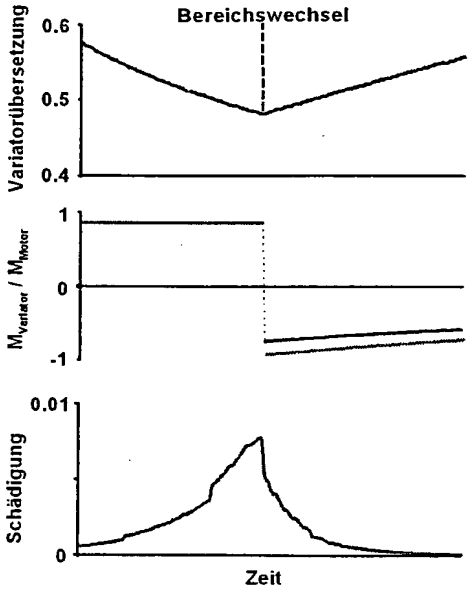


Figur 102

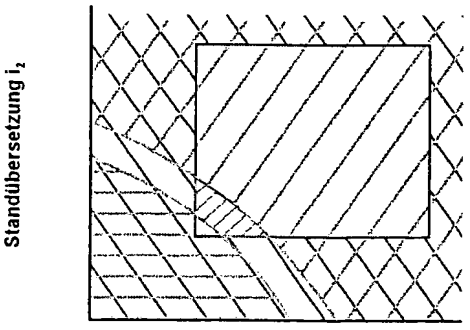
zu hohe Variatormomente am Bereichswechsel



Figur 103



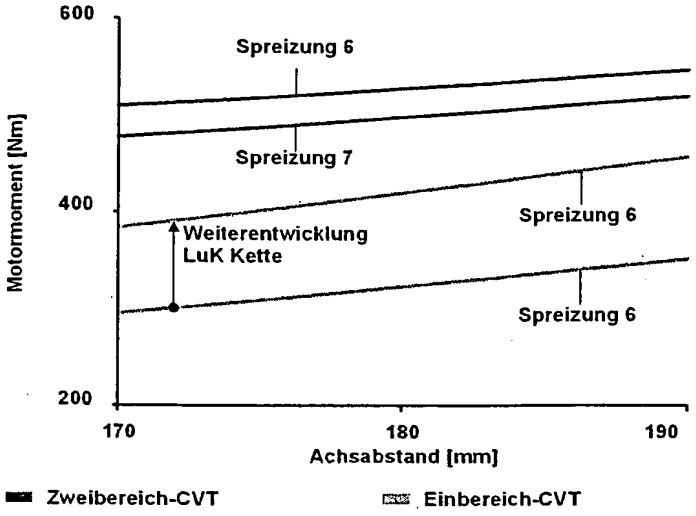
Figur 104



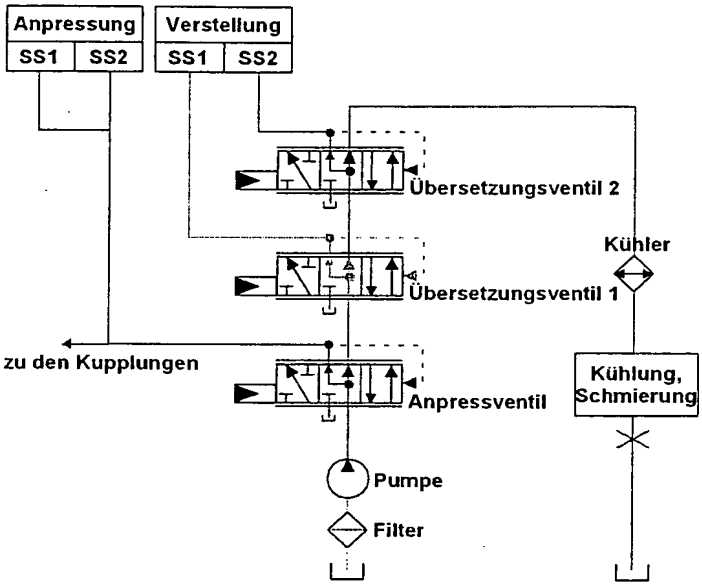
Ausschlusskriterien:

- R-Übersetzung, Variatormoment
- Bauraumbedingungen
- Spreizung

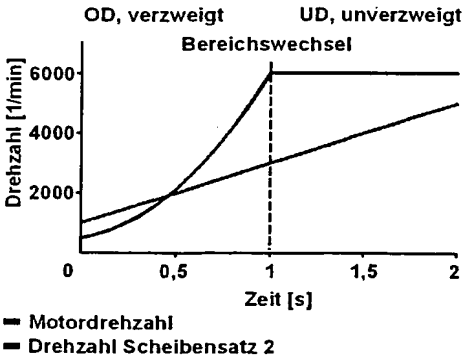
Figur 105



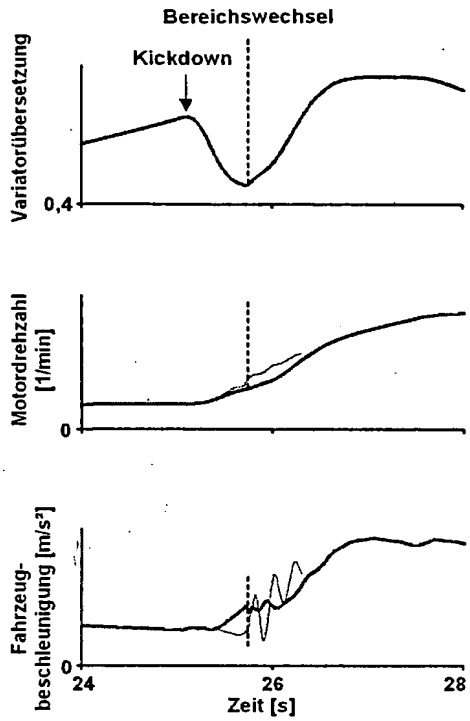
Figur 106



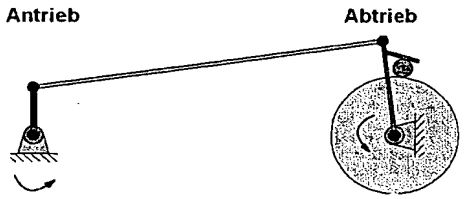
Figur 107



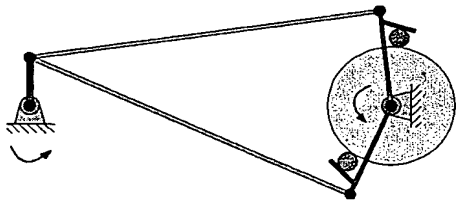
Figur 108



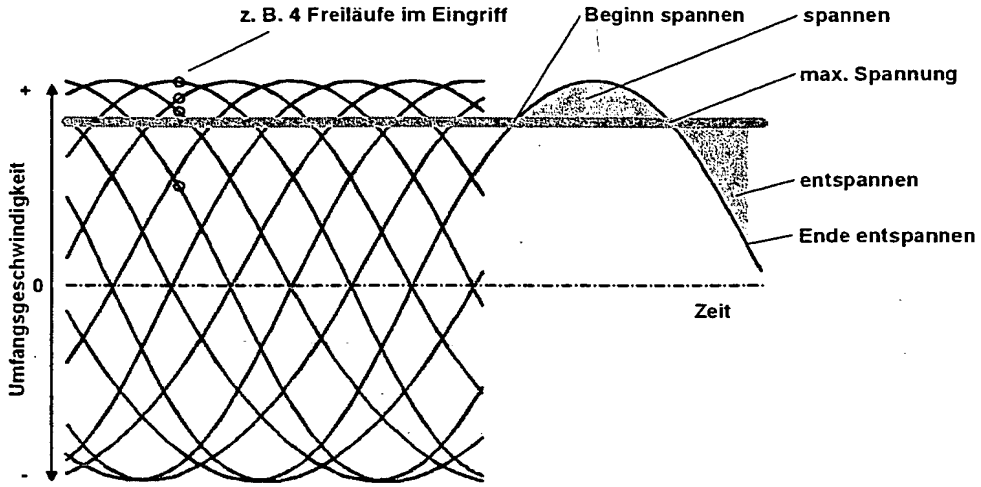
Figur 109



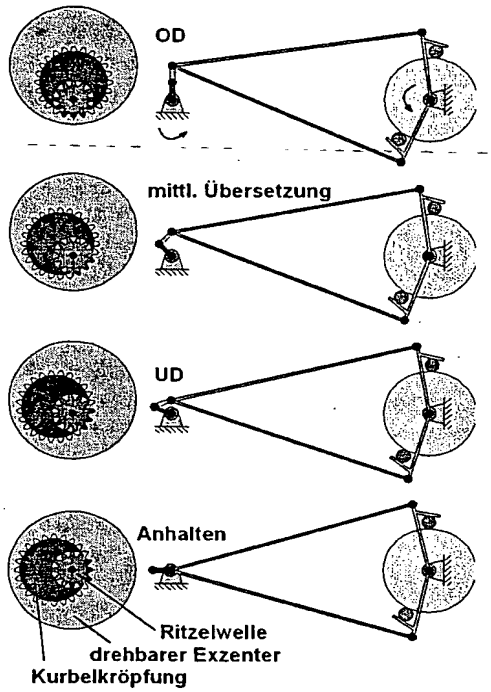
Figur 110



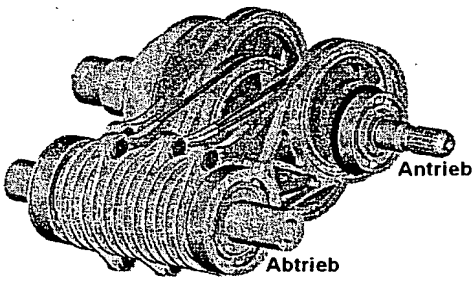
Figur 111



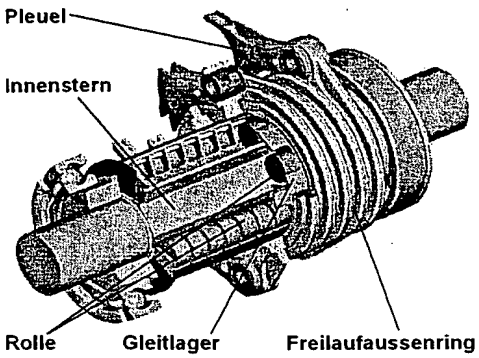
Figur 112



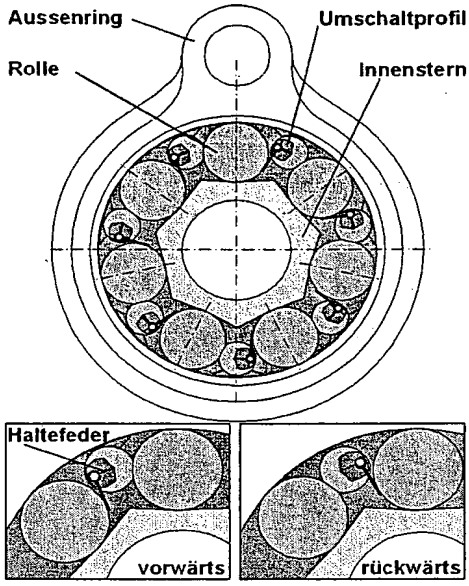
Figur 113



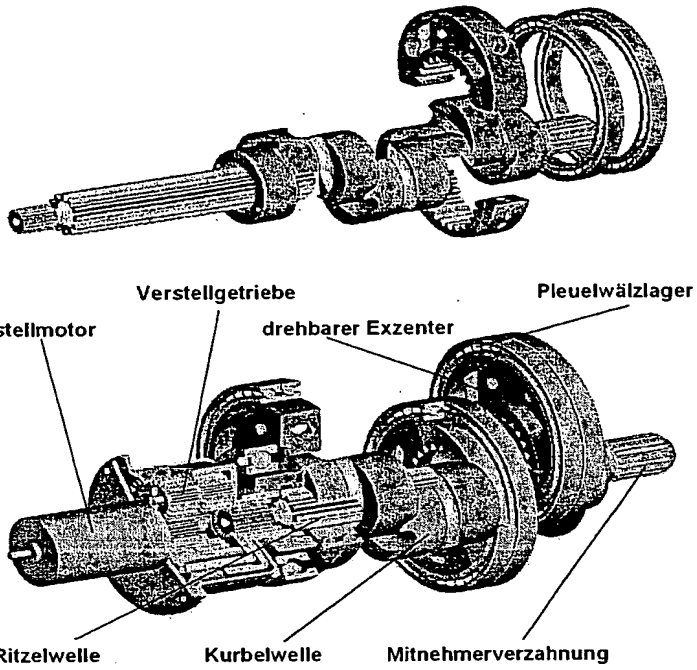
Figur 114



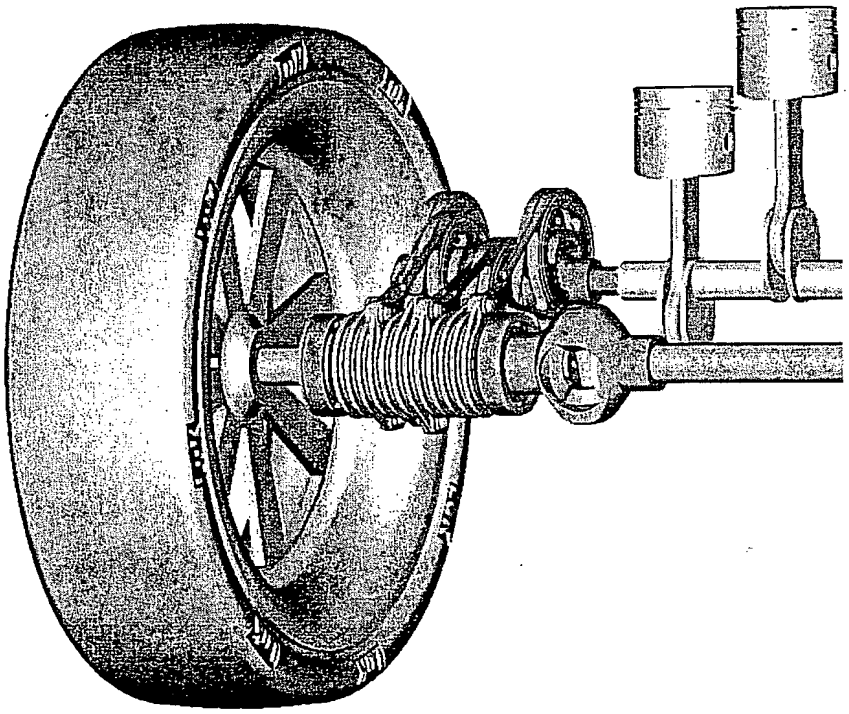
Figur 115



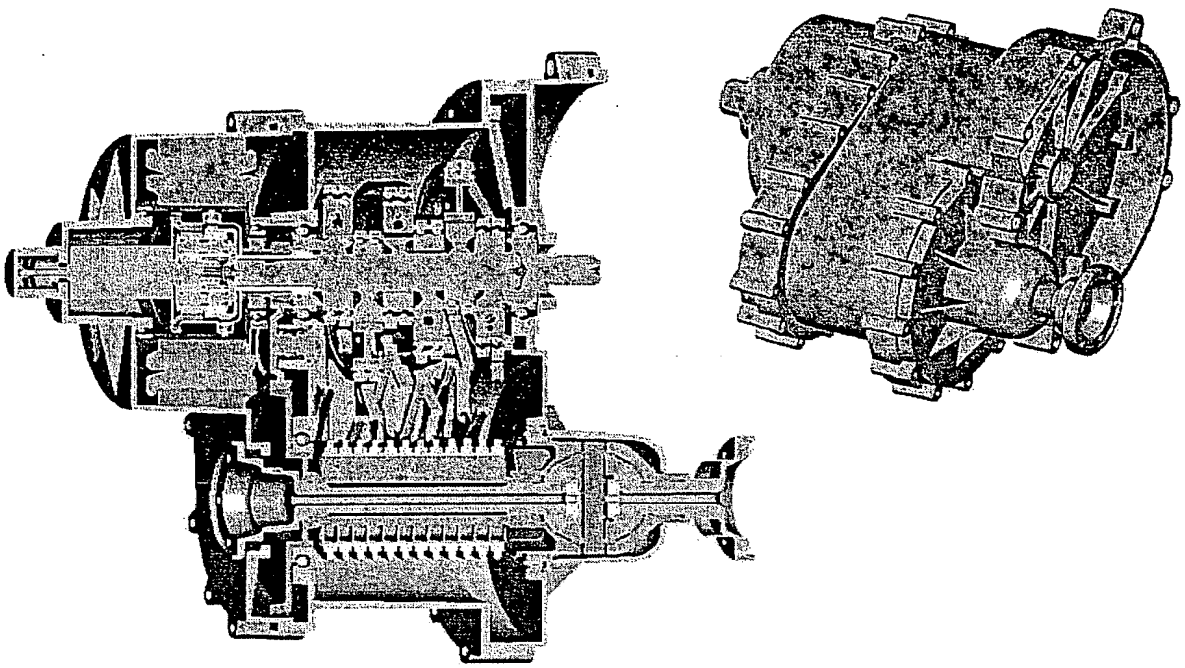
Figur 116



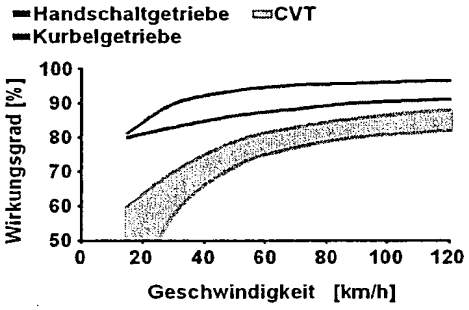
Figur 117



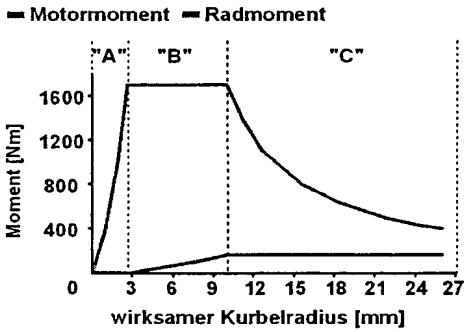
Figur 118



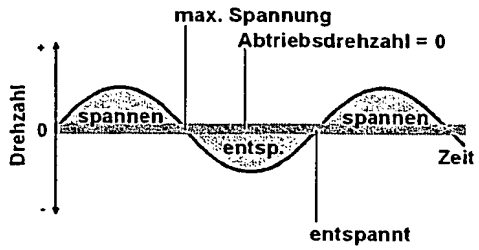
Figur 119



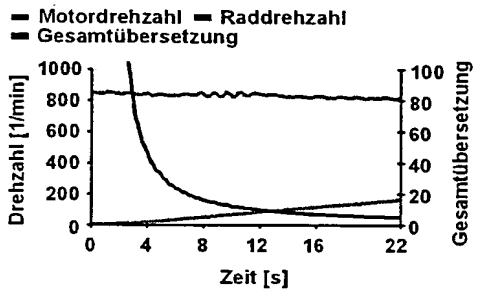
Figur 120



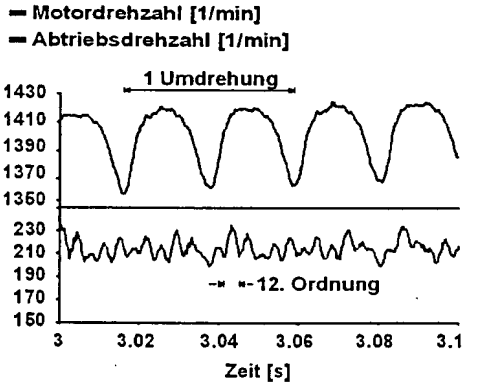
Figur 121



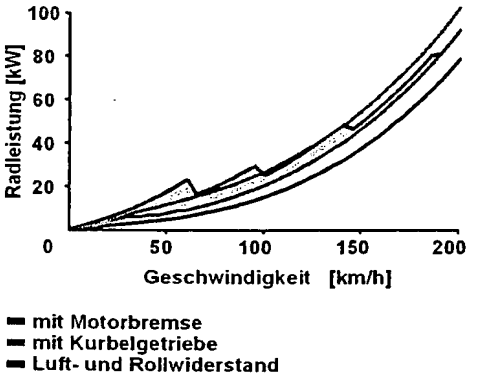
Figur 122



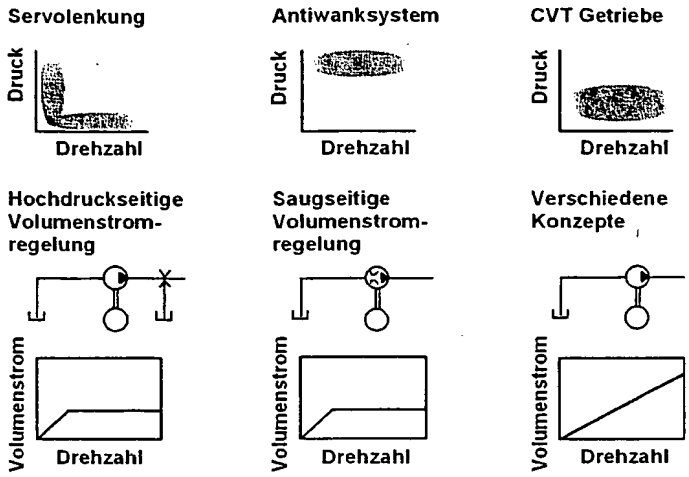
Figur 123



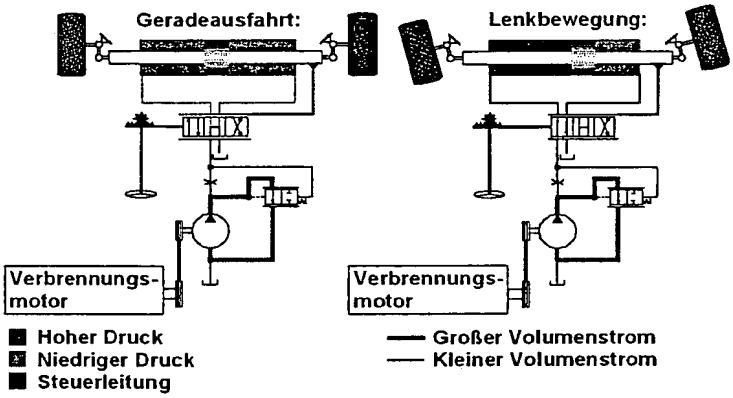
Figur 124



Figur 125

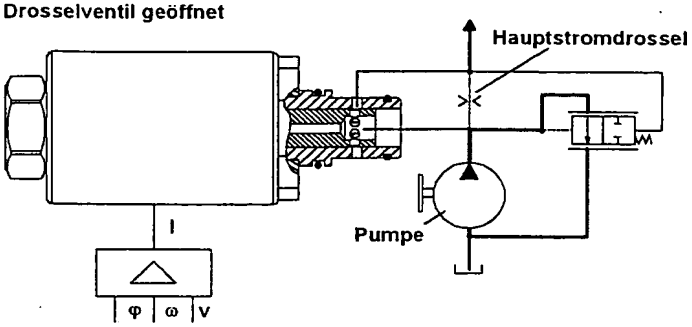


Figur 126

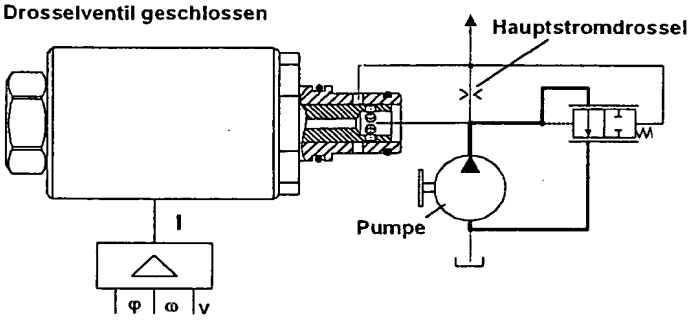


Figur 127

Drosselventil geöffnet



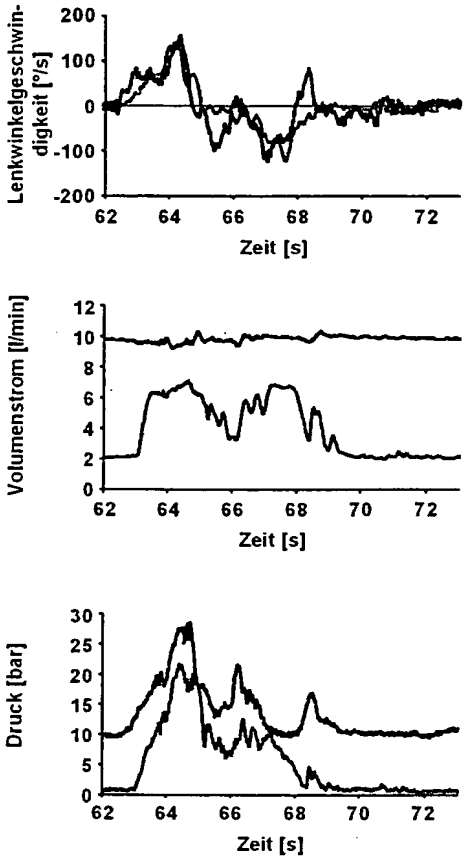
Drosselventil geschlossen



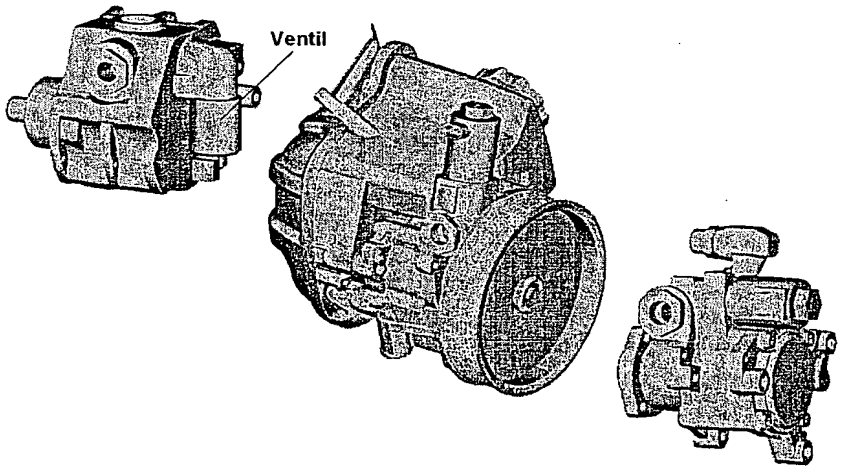
Hoher Druck
Niedriger Druck
Steuerleitung

Großer Volumenstrom
Kleiner Volumenstrom

Figur 128



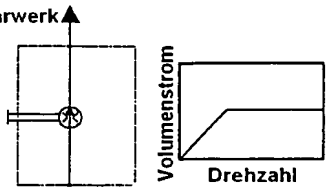
Figur 129



Figur 130

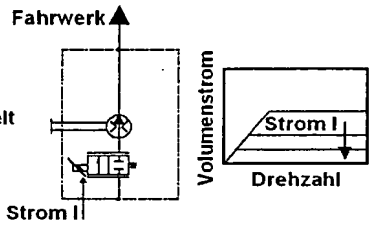
Open Center
Antiwanksystem

Pumpe intern sauggedrosselt

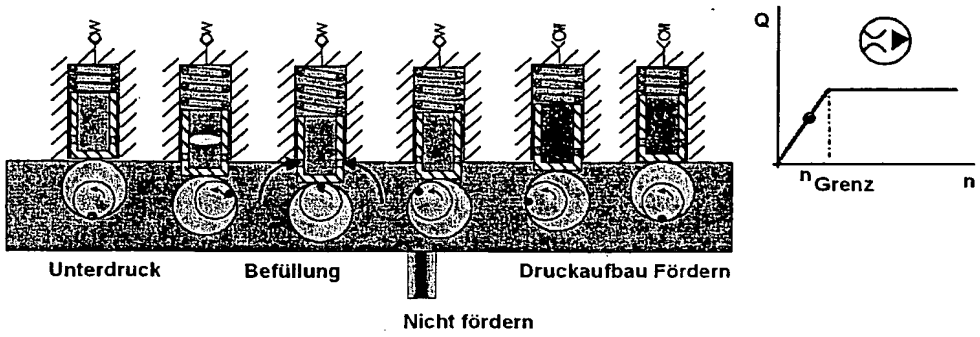


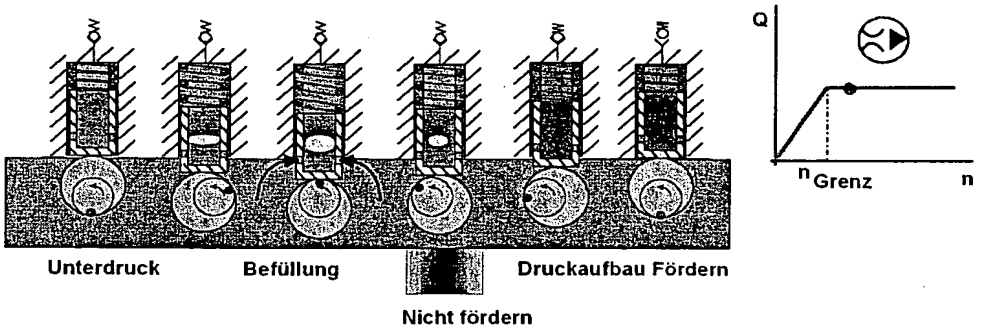
Closed Center
Antiwanksystem

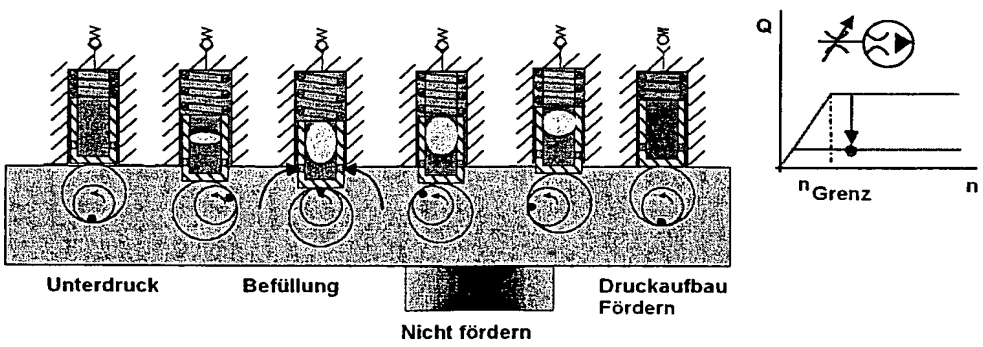
Pumpe intern sauggedrosselt
und extern ansteuerbar
sauggedrosselt



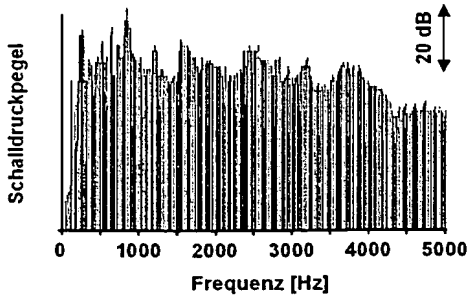
Figur 131


OV
OV
OV
OV
OM
OM
Unterdruck
Befüllung
Druckaufbau Fördern
Nicht fördern
Q
n Grenz
n


OV
OV
OV
OV
OV
OM
Unterdruck
Befüllung
Druckaufbau Fördern
Nicht fördern
Q
n Grenz
n


OV
OV
OV
OV
OV
OM
Unterdruck
Befüllung
Druckaufbau
Fördern
Nicht fördern
Q
n Grenz
n

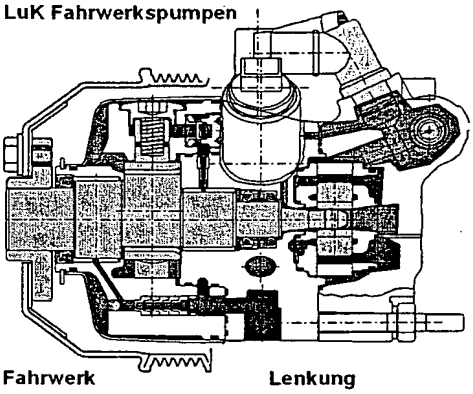
Figur 132



- Ausgangszustand
- Optimiertes Design

Figur 133

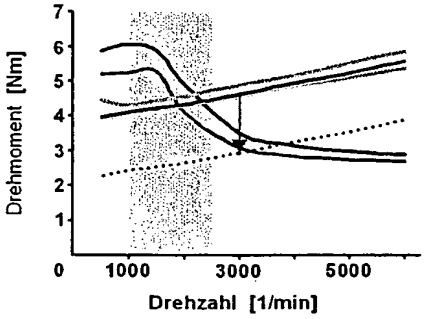
LuK Fahrwerkspumpen



Fahrwerk	Lenkung
V_{geo} = 6 - 6,7 cm³	V_{geo} = 8,4 - 15 cm³
p_{max} = 200 bar	p_{max} = 135 bar

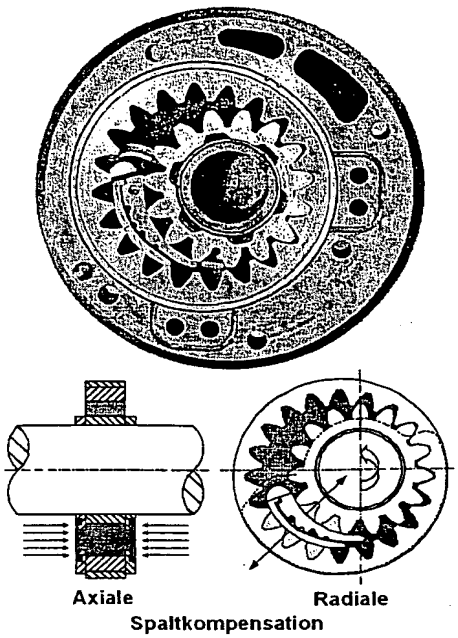
Figur 134

n = 1000 min⁻¹, Q = 10,5 l/min, p = 20 bar, T = 90°C, Q_{max} erforderlich = 15 l/min

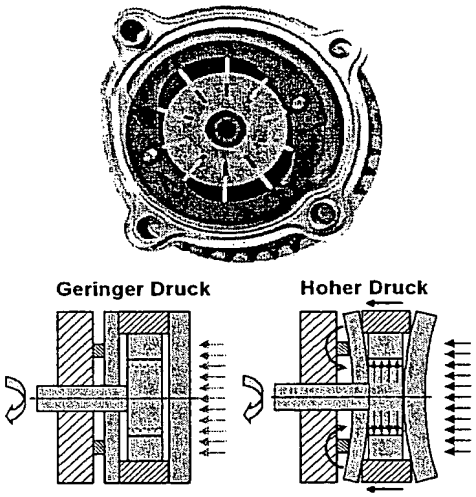


- Sauggedrosselte Radialkolbenpumpe
- Verstellbare Flügelzellenpumpe
- Kompensierte Innenzahnradpumpe
- Konstant-Flügelzellenpumpe
- Zweiflutige FZP - zweiflutiger Betrieb 100%
- Zweiflutige FZP - einflutiger Betrieb 50%

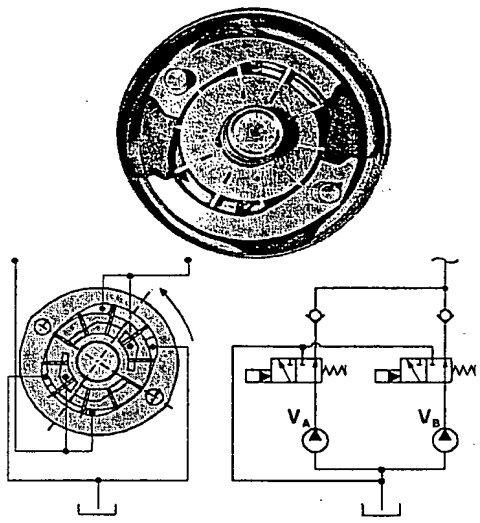
Figur 135



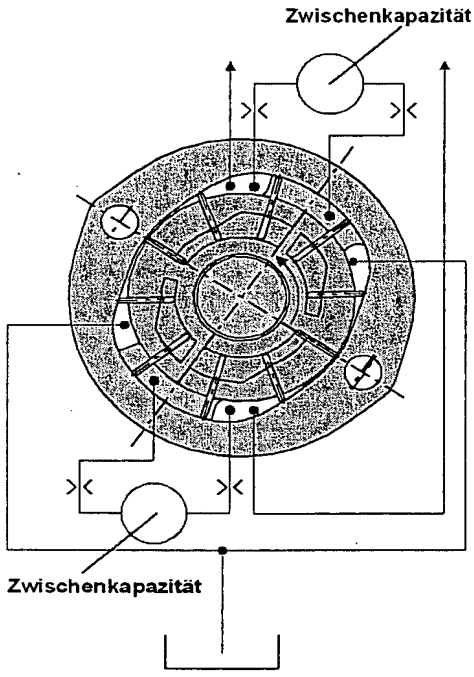
Figur 136



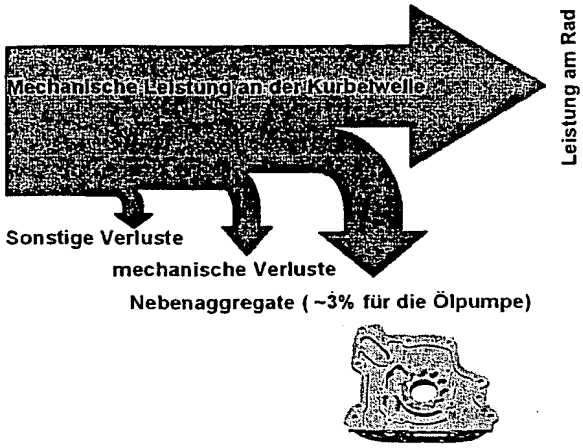
Figur 137



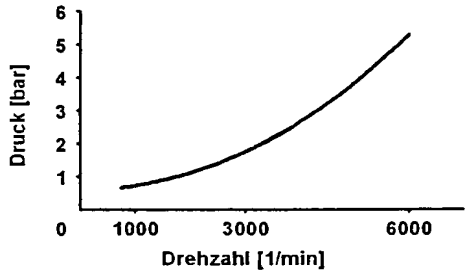
Figur 138



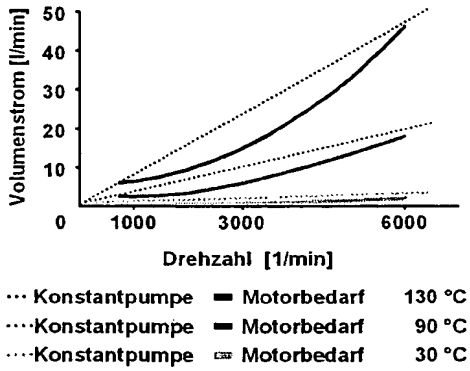
Figur 139



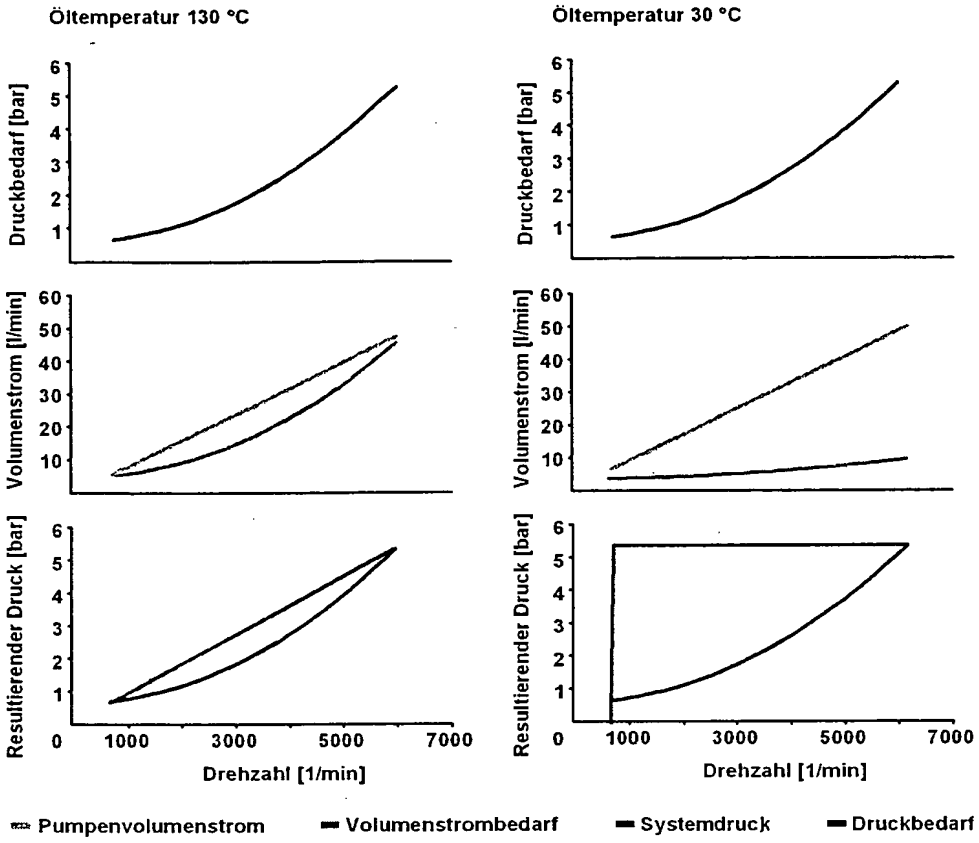
Figur 140



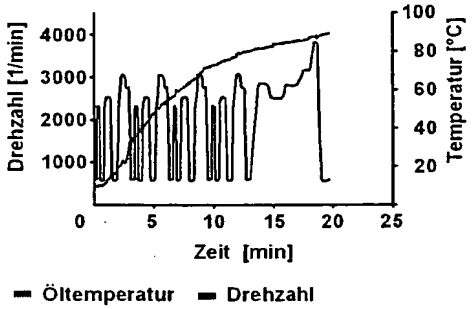
Figur 141



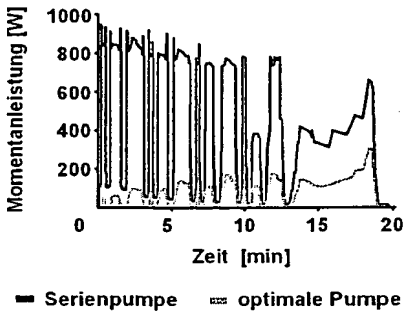
Figur 142



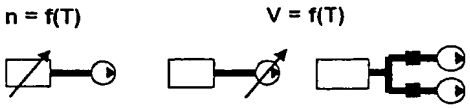
Figur 143



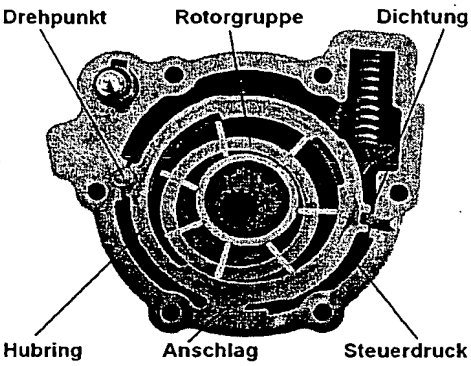
Figur 144



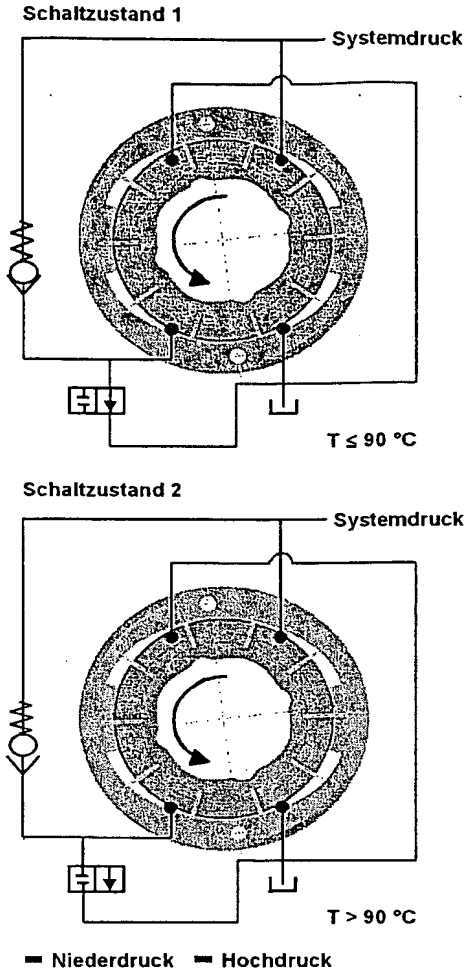
Figur 145



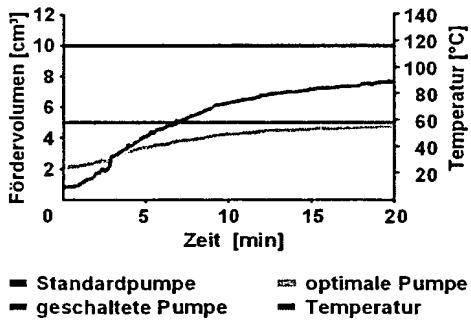
Figur 146



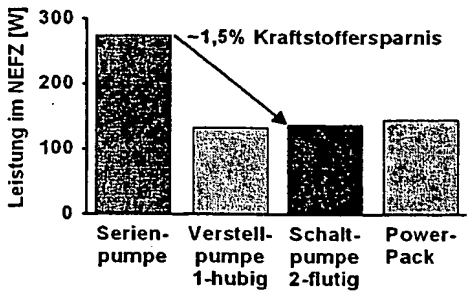
Figur 147



Figur 148



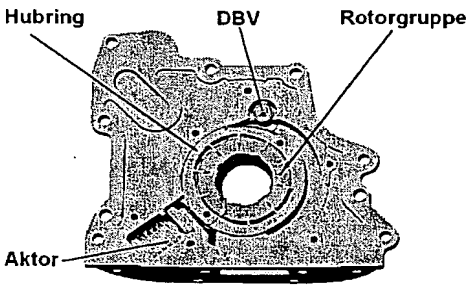
Figur 149



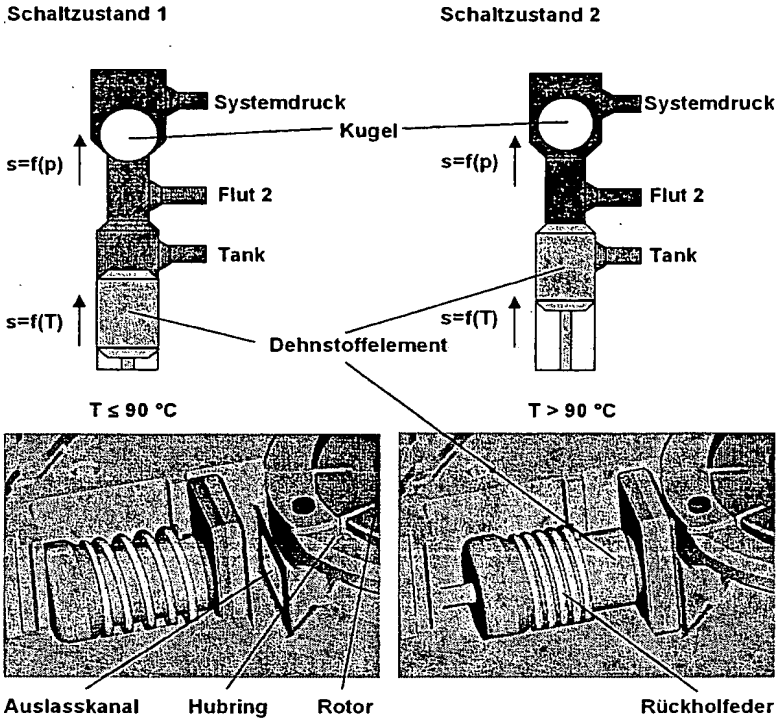
Figur 150

Lösungsprinzip	Variabler E-Motor	Variabler Hub	Schalt-pumpe
Annäherung an den Druckbedarf	☺	☺	😐
Leistungsbedarf	☺	☺	☺
Betriebssicherheit	😐	☺	☺
Bauraum	☹	😐	☺
Kosten	☹	😐	😐

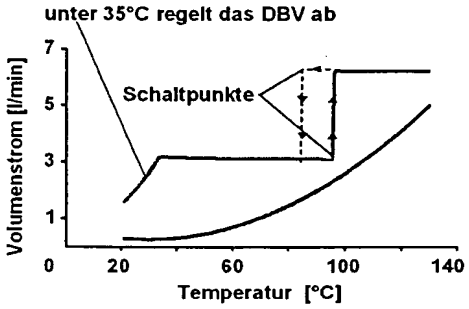
Figur 151



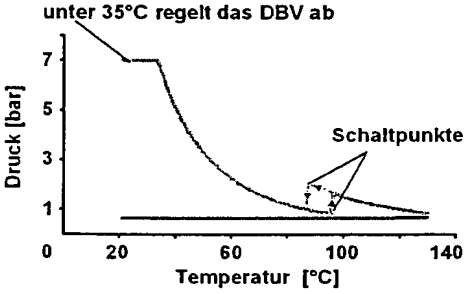
Figur 152



Figur 153

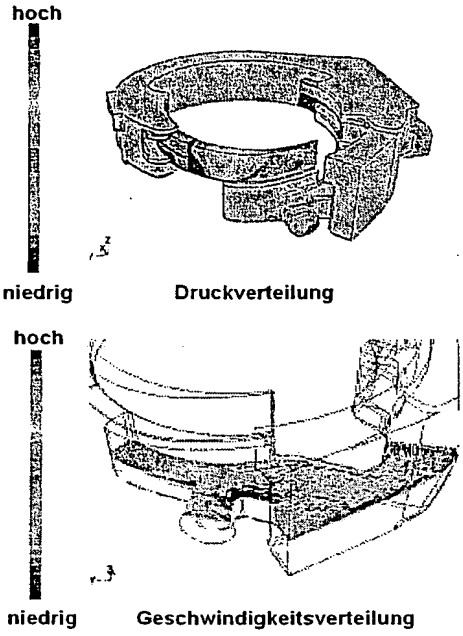


Systemvolumenstrom
Volumenstrombedarf



Systemdruck
Druckbedarf

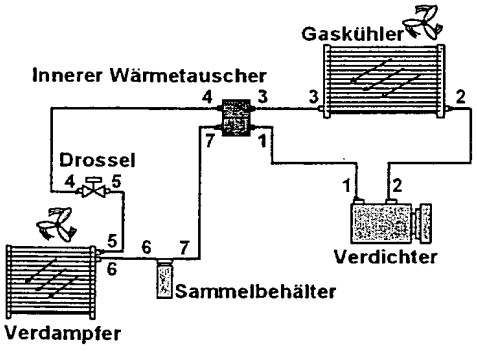
Figur 154



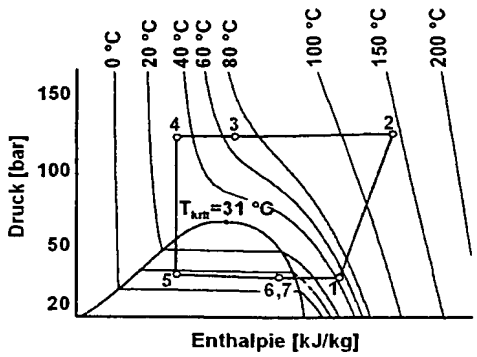
Figur 155

Name	HCFC (R12)	HFC (R134a)	CO_2 (R744)
Ozonschädigung	ja	ja	keine, da natürliches Gas
Treibhauspotenzial	GWP = 8100	GWP = 1300	GWP = 1
CO_2 Ausstoß durch Betrieb	2600 kg / PKW	2600 kg / PKW	1800 kg / PKW
CO_2 GWP-Äquivalent über Lebensdauer	8100 kg / PKW	1300 kg / PKW	0,5 kg / PKW
Summe	10700 kg / PKW	3900 kg / PKW	1800,5 kg / PKW

Figur 156



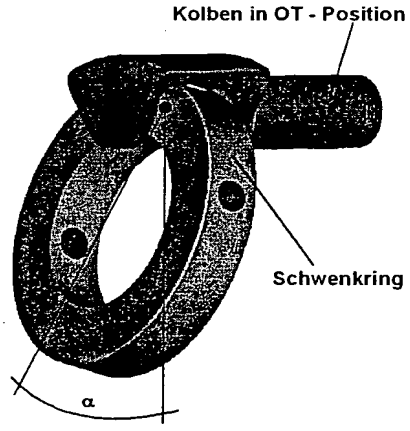
Figur 157



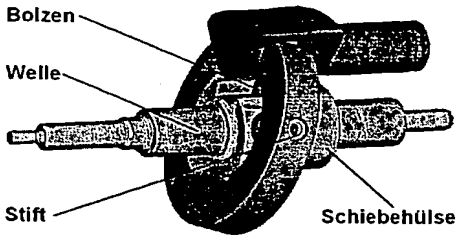
Figur 158

Bauart	Flügelzellenverdichter	Spiralverdichter	Axialkolbenverdichter
Massenstrom-regelung	**Bypass**	**Bypass**	**Hubverstellung über Schwenkmechanis-mus**
Wirkungsgrad der Kli-maanlage, Verdichter mit max. Massen-strom (COP)	(2)	(2)	(2)
Wirkungsgrad der Kli-maanlage, Verdichter mit abgeregeltem Massenstrom (COP)	(1)	(1)	(1,8)
Geräusch			
Kosten			

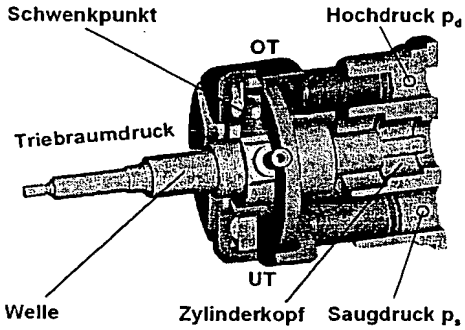
Figur 159



Figur 160

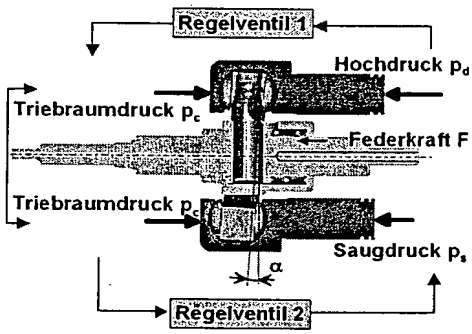


Figur 161



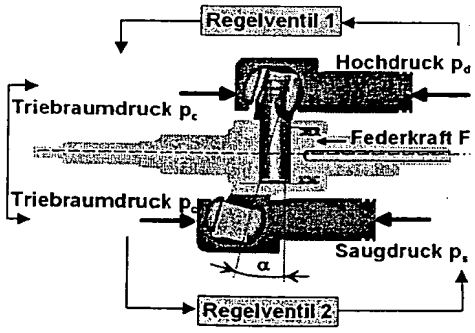
Figur 162

Schwenkwinkel α bei $p_c > p_s$



Figur 163

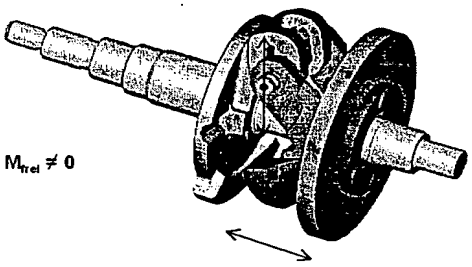
Schwenkwinkel α bei $p_c = p_s$



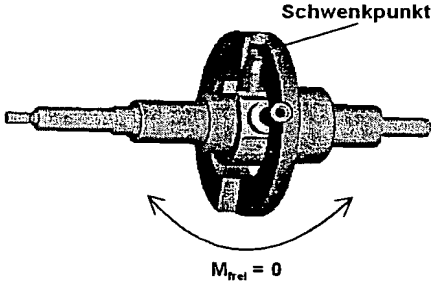
Figur 164

Schwenk-mechanismus	Maximal-drehzahl	Regelbarkeit bei CO_2	Geräusch
Taumelscheibe			
Schwenkscheibe			
Schwenkring			

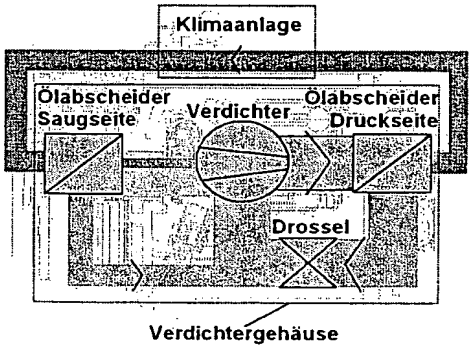
Figur 165



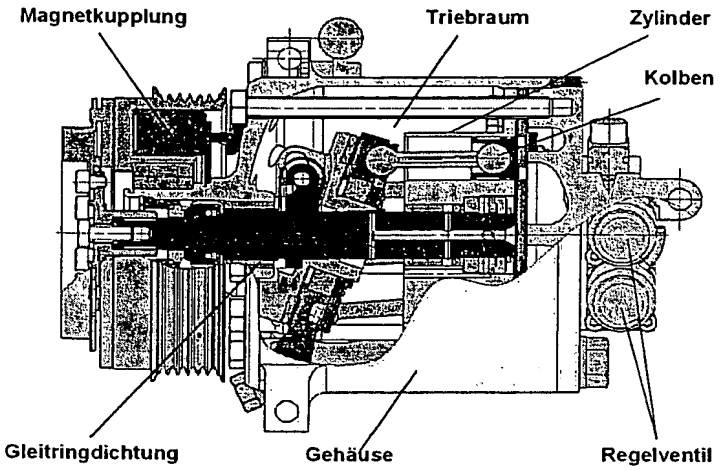
Figur 166



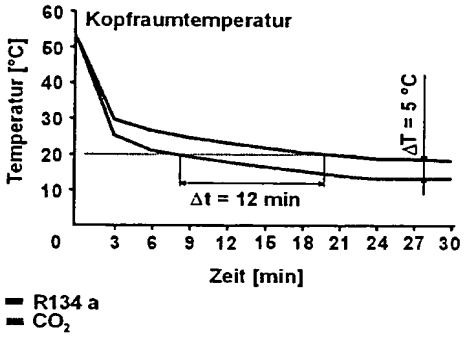
Figur 167



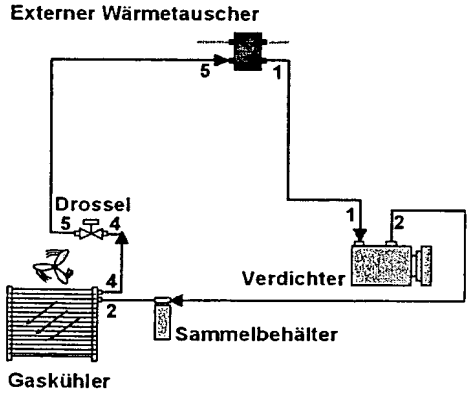
Figur 168



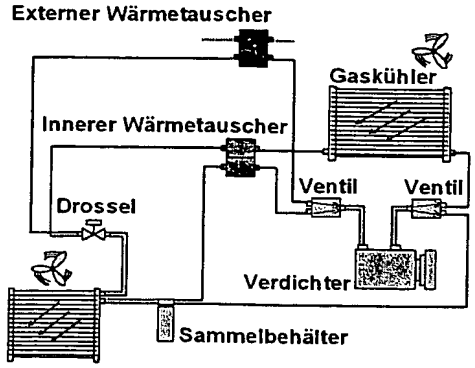
Figur 169



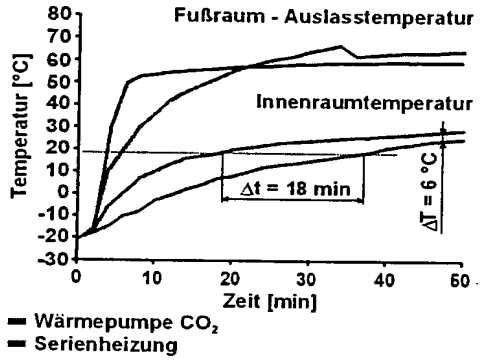
Figur 170



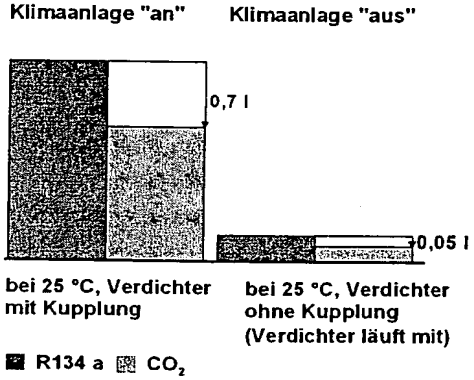
Figur 171



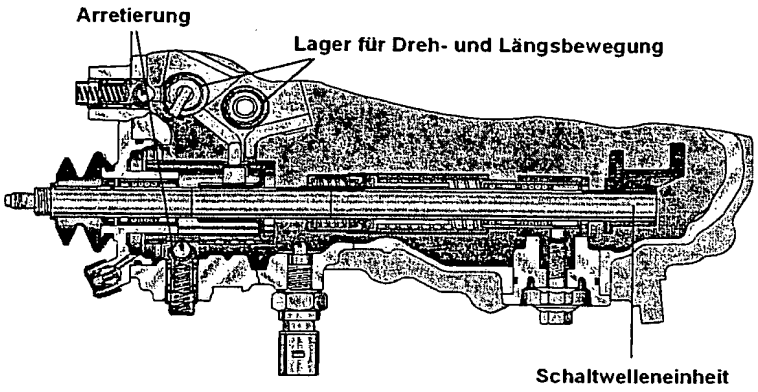
Figur 172



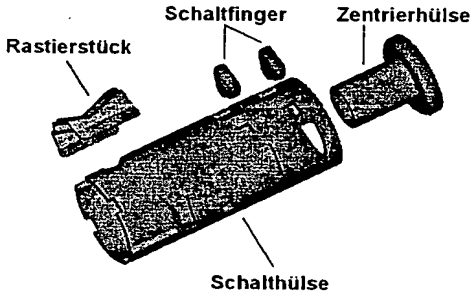
Figur 173



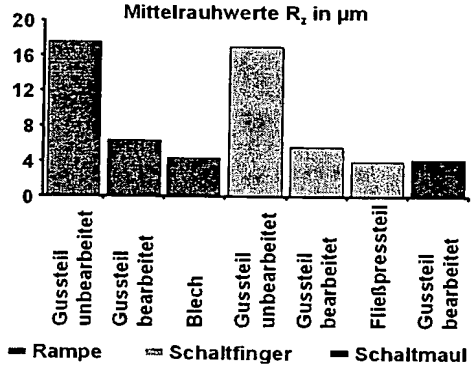
Figur 174



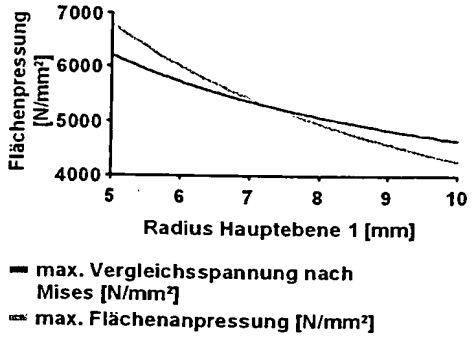
Figur 175



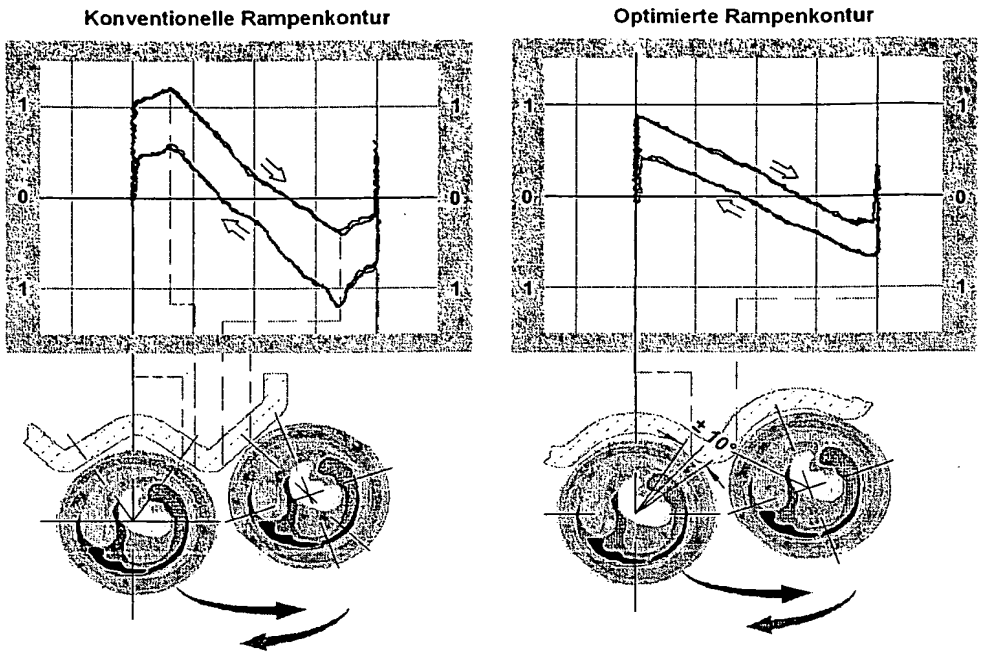
Figur 176



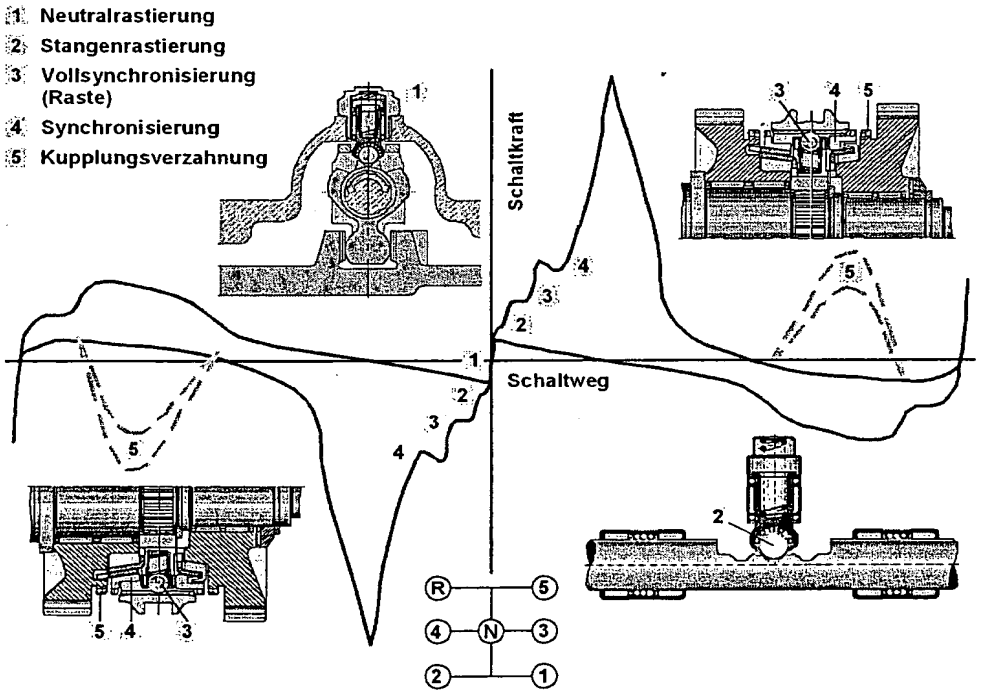
Figur 177



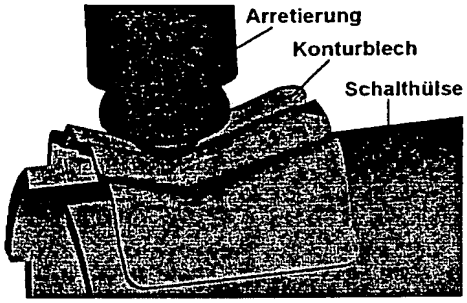
Figur 178



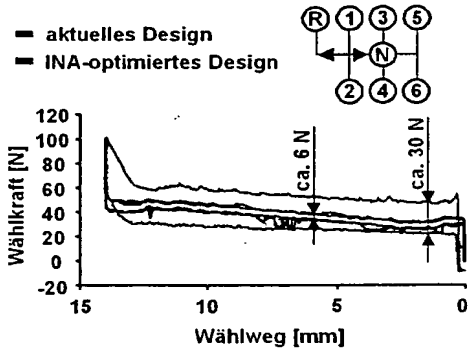
Figur 179



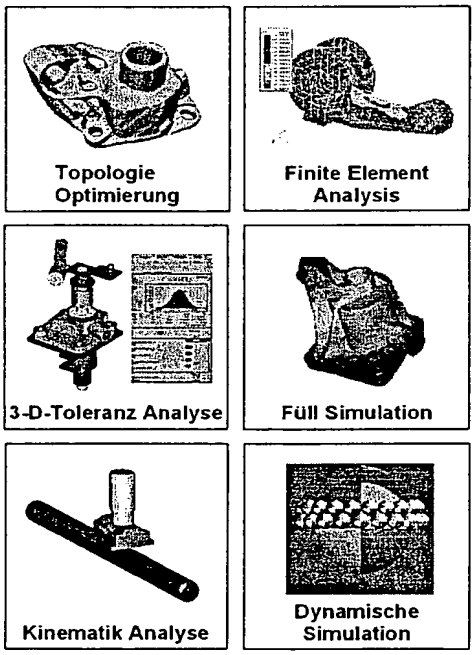
Figur 180



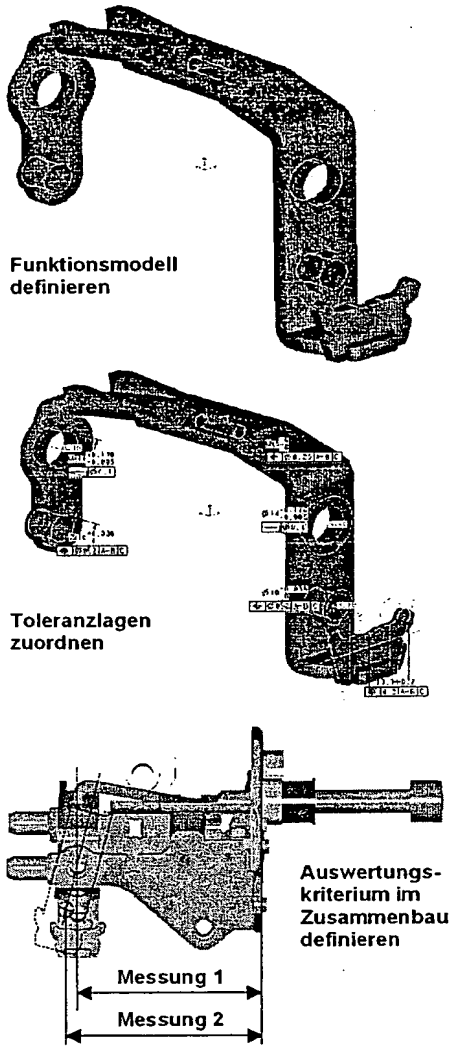
Figur 181



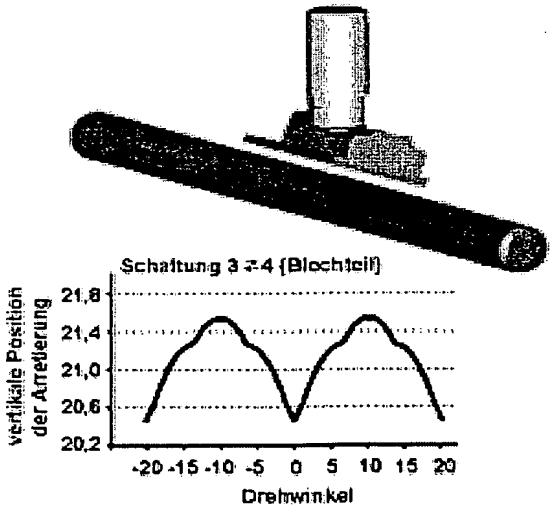
Figur 182



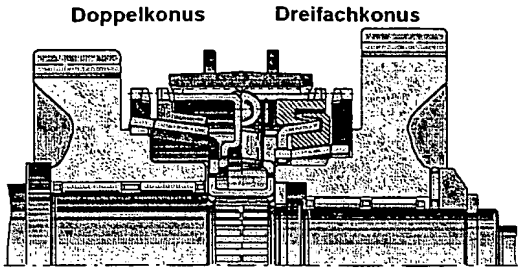
Figur 183



Figur 184

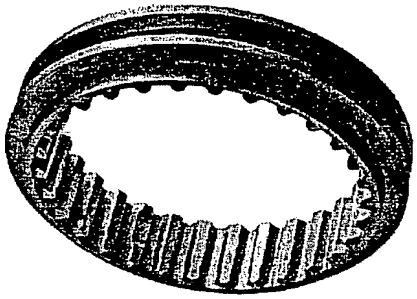


Figur 185

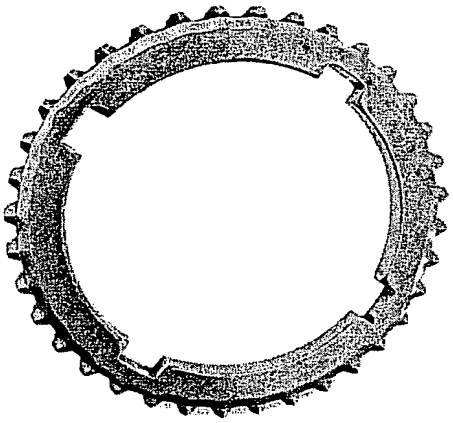


- Vorsynchronisation
- Außensynchronisation
- Zwischenring
- Innensynchronisation
- Kupplungsverzahnungsscheibe
- Radkonusring
- Schiebemuffe
- Synchronkörper

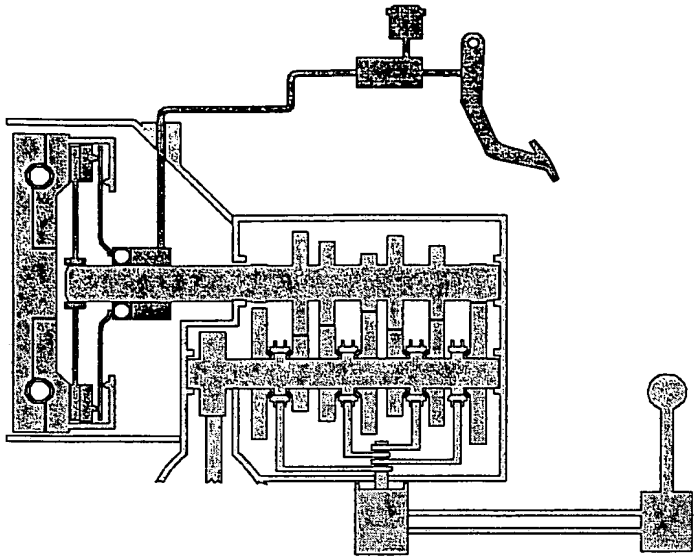
Figur 186



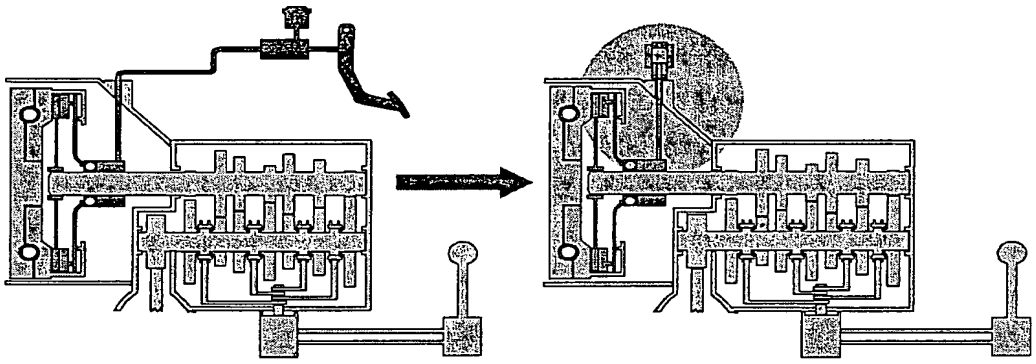
Figur 187



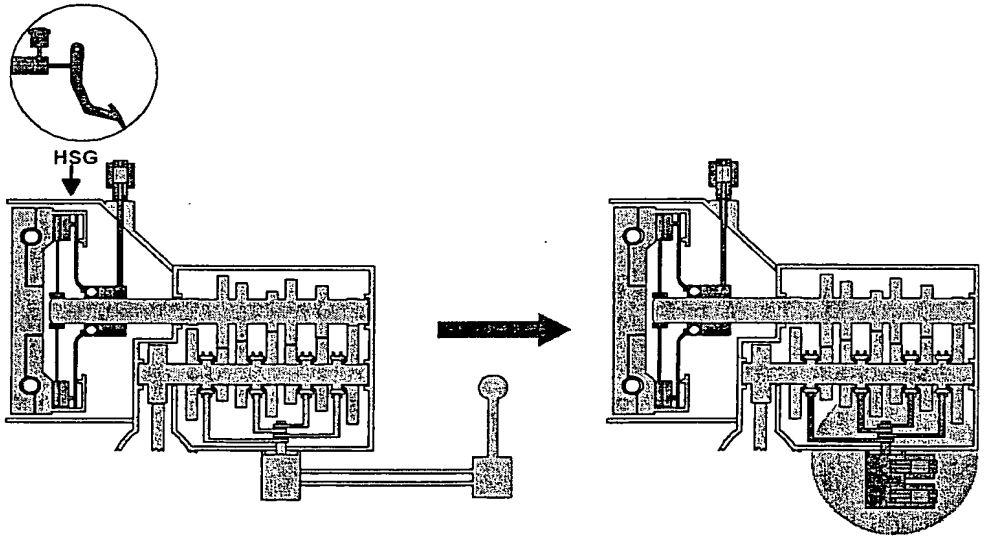
Figur 188



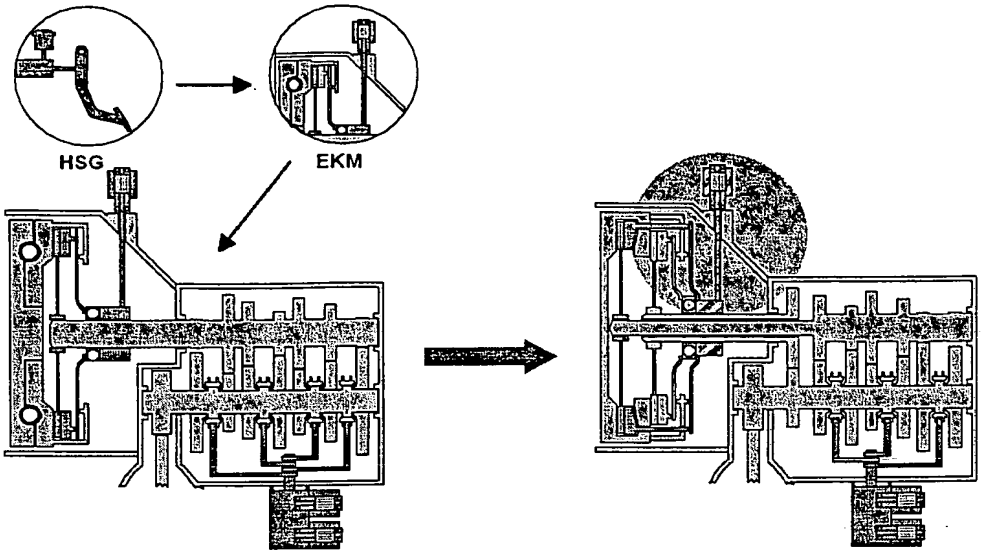
Figur 189



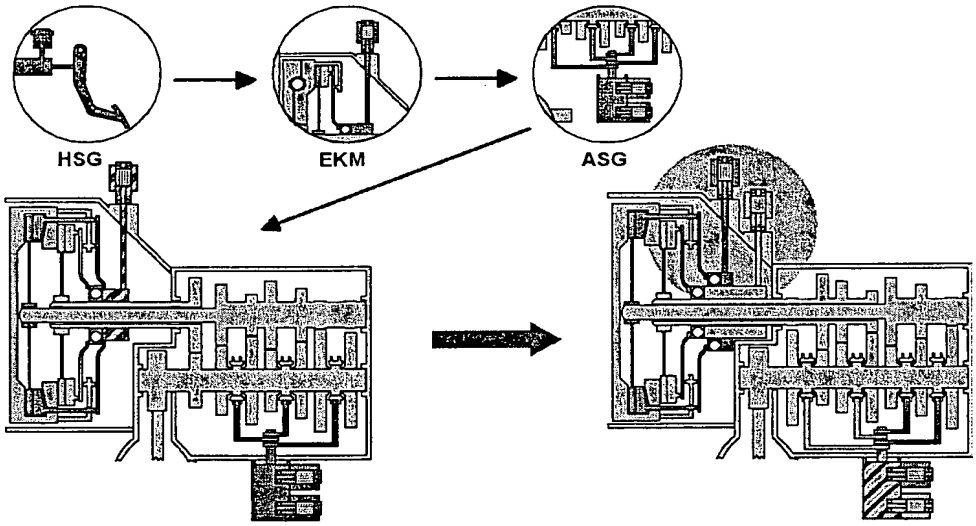
Figur 190



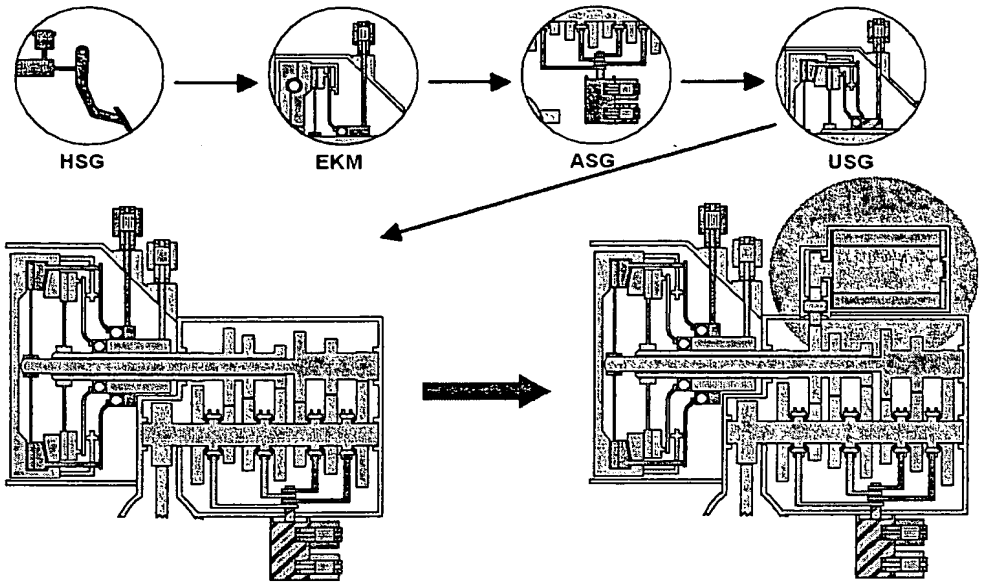
Figur 191



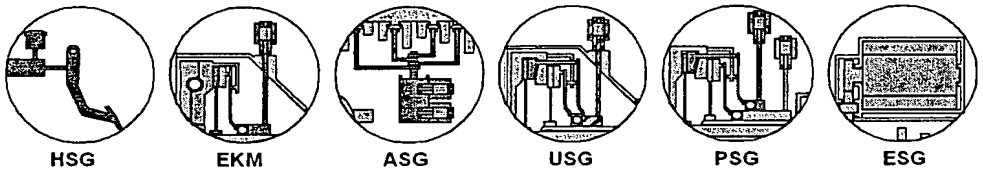
Figur 192



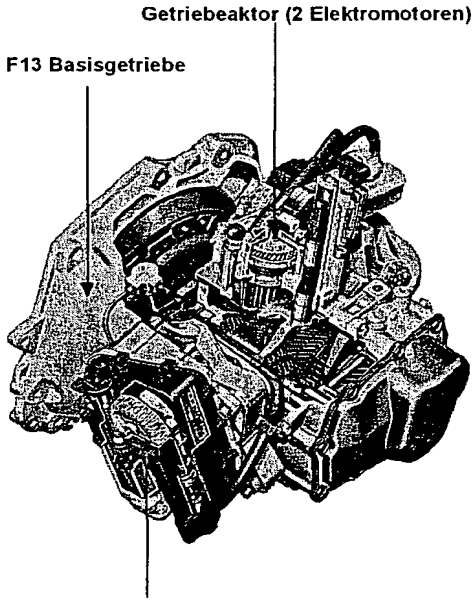
Figur 193



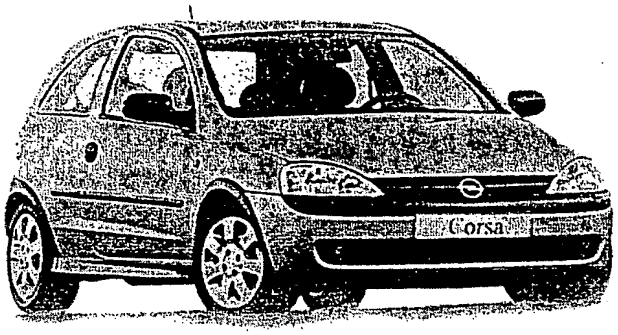
Figur 194



Figur 195



Figur 196



ASG mit 3 Elektromotoren (in Kooperation mit BOSCH)
Opel Corsa Easytronic[4]

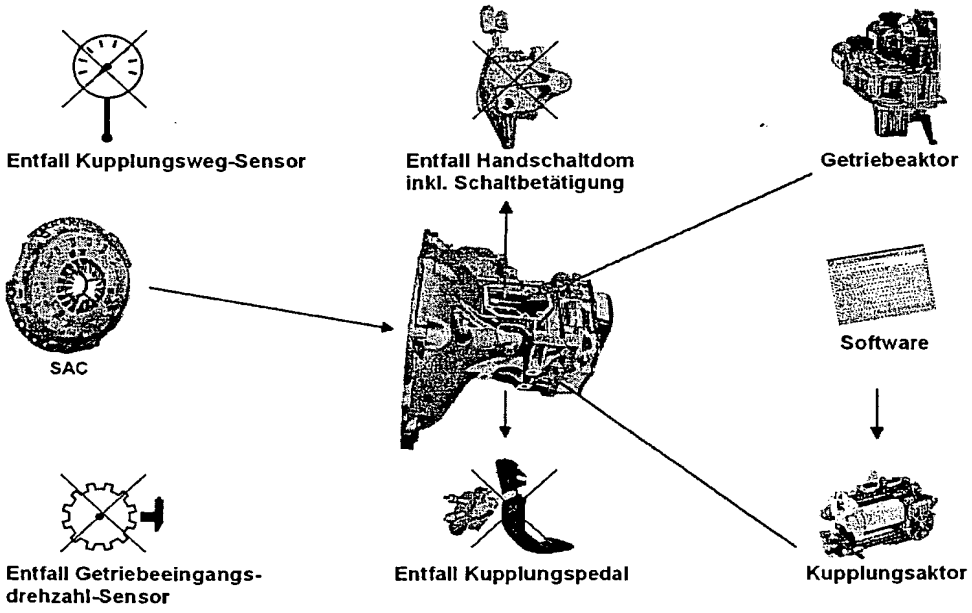
EKM hydraulisch
z. B. Renault Twingo

ASG hydraulisch
z. B. Toyota MR 2

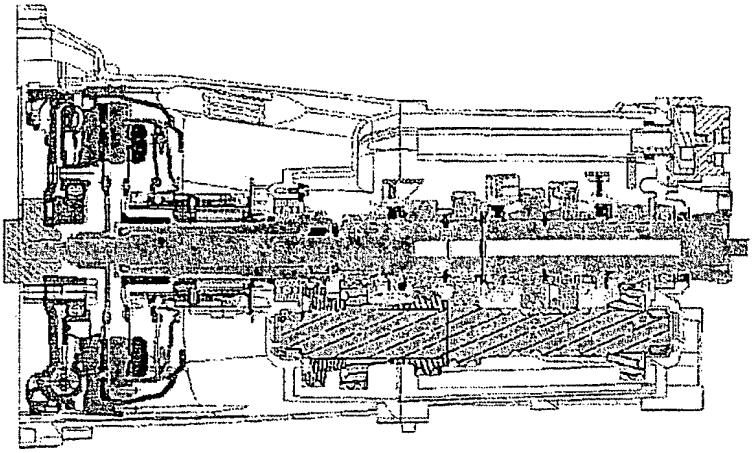
EKM elektromotorisch
z. B. DC A-Klasse

ASG-Schaltwalze elektro-
motorisch z. B. Opel
Maxx Show Car

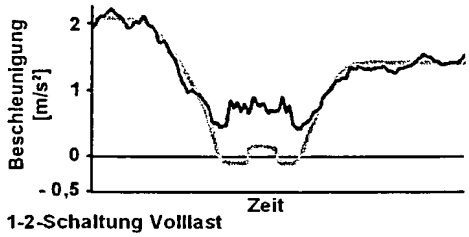
Figur 197



Figur 198



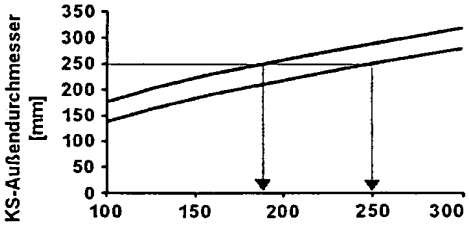
Figur 199



1-2-Schaltung Volllast

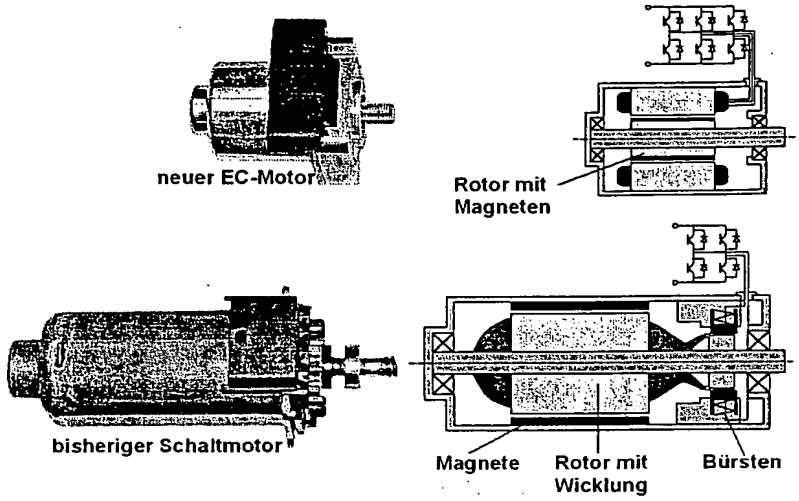
Fahrzeugbeschleunigung ASG
Fahrzeugbeschleunigung USG (Messung)

Figur 200

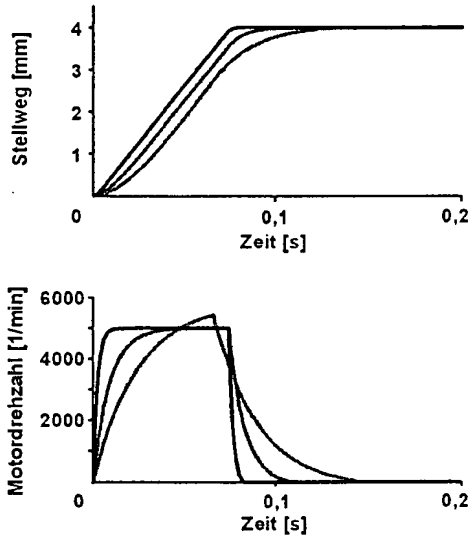


Diesel
Benzin

Figur 201



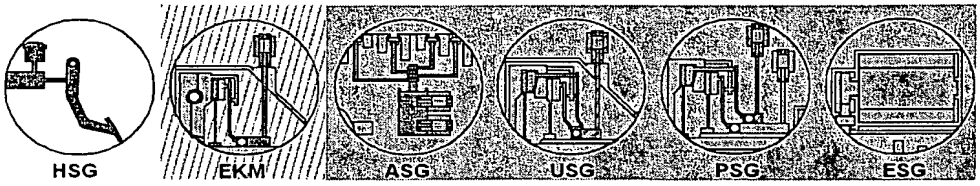
Figur 202

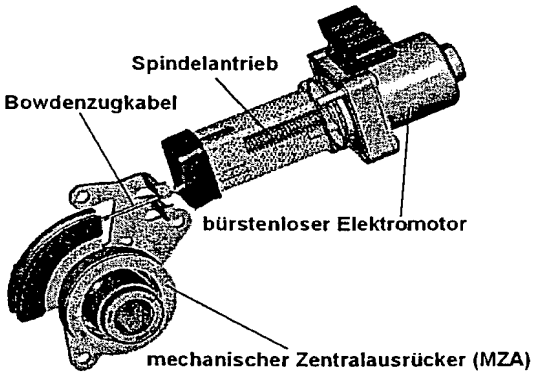


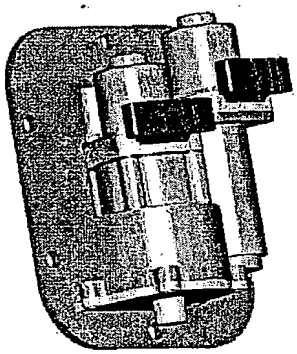
Figur 203

	heutiger Kupplungs-motor (DC)	heutiger Schaltmotor (DC)	neuer Motor (EC)
Leistungsdichte	101 W/kg 100%	163 W/kg 162%	267 W/kg 266%
Massenträgheit	30,4 * 10^{-6} kgm^2 100%	25,0 * 10^{-6} kgm^2 82%	6,5 * 10^{-6} kgm^2 21%
mechanische Zeitkonstante	27,75 ms 100%	7,46 ms 27%	1,88 ms 6,8%
Gewicht	693 g 100%	813 g 117%	438 g 63%
Volumen	166 cm^2 100%	162 cm^2 98%	62 cm^2 37%

Figur 204



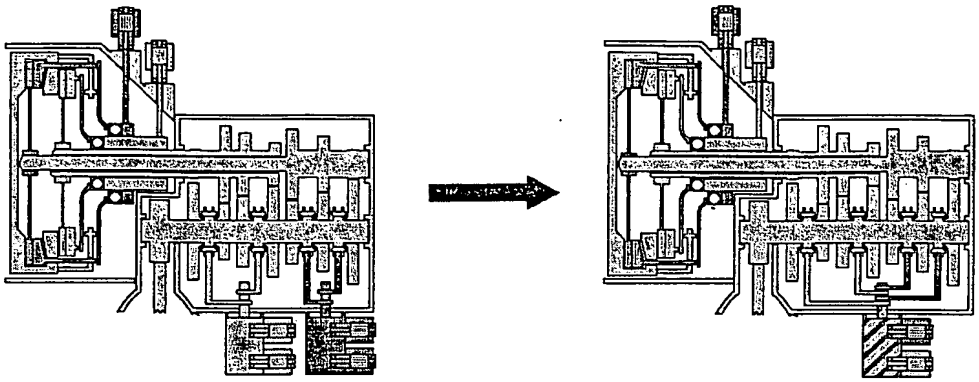




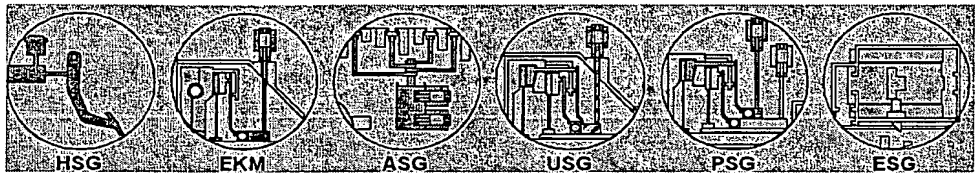
Kupplungsaktor

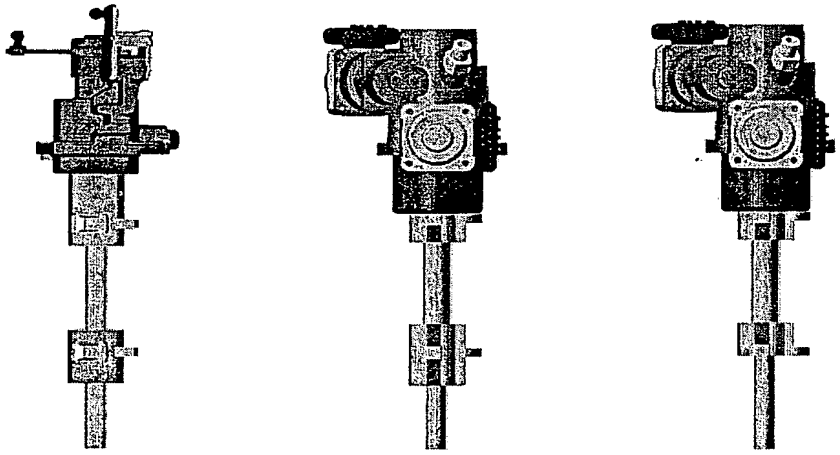
Getriebeaktor

Figur 205



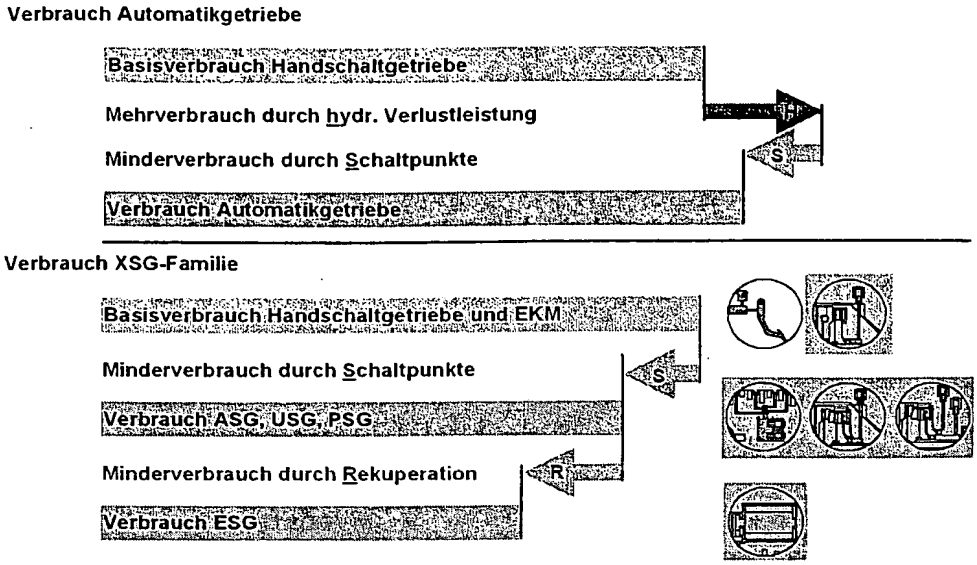
Figur 206



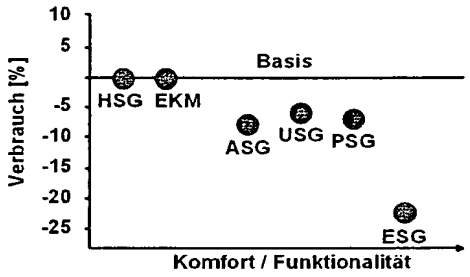


auf der Basis der neuen Elektromotoren

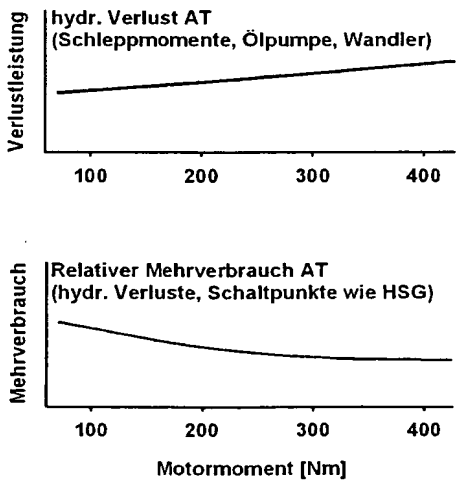
Figur 207



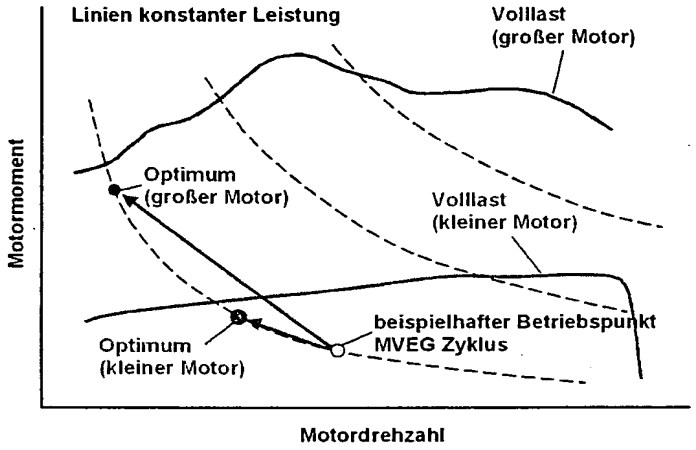
Figur 208



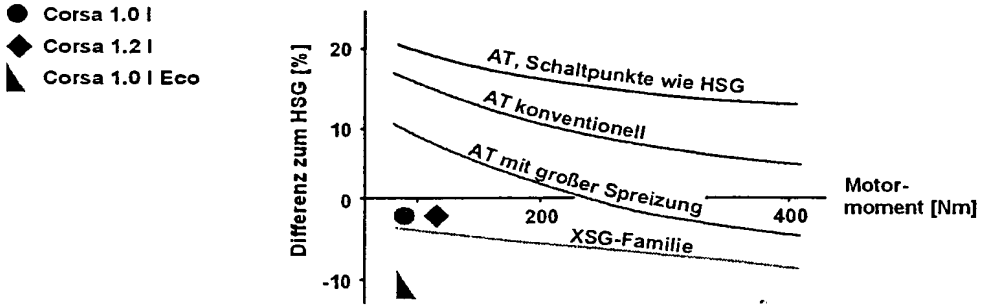
Figur 209



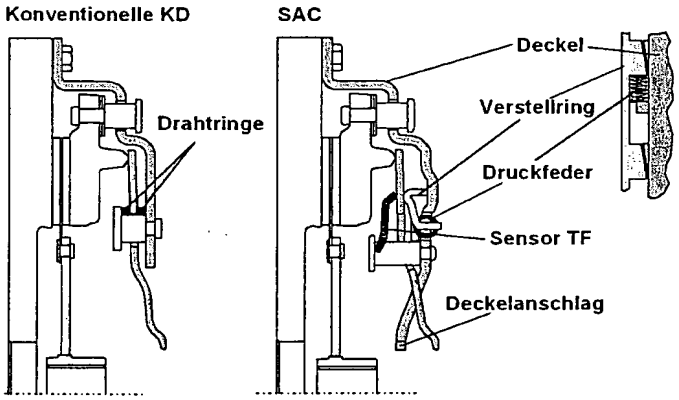
Figur 210



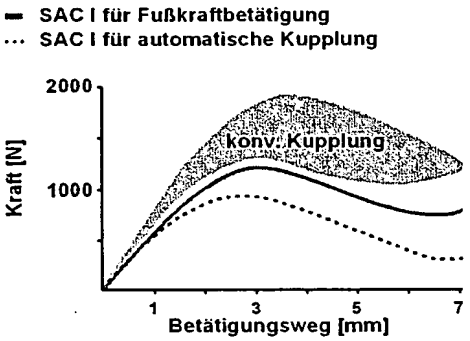
Figur 211



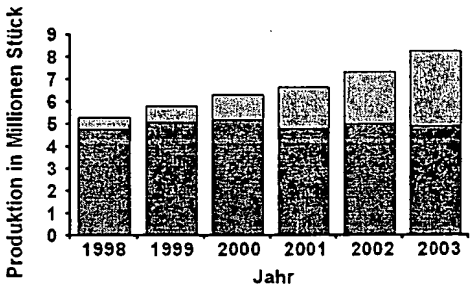
Figur 212



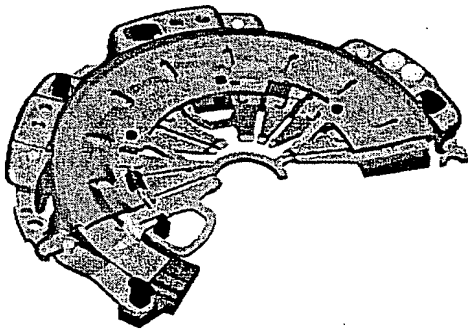
Figur 213



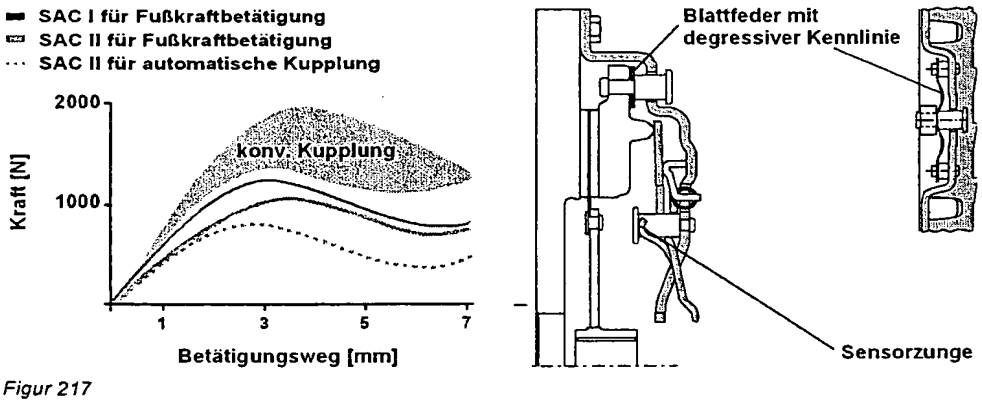
Figur 214



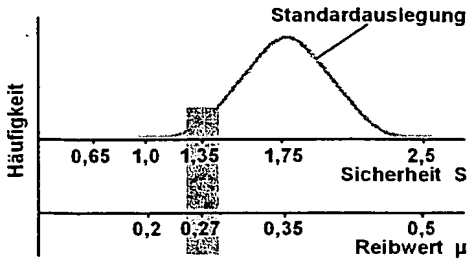
Figur 215



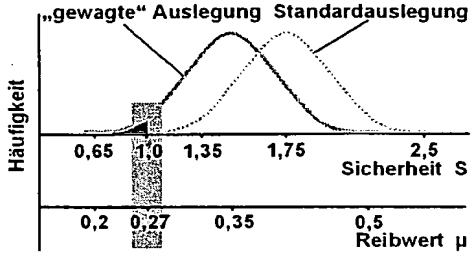
Figur 216



Figur 217

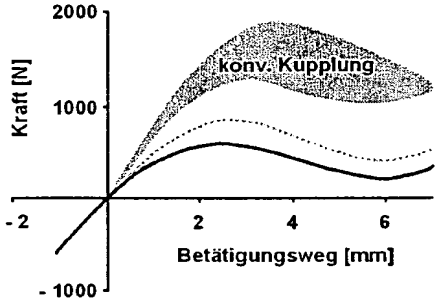


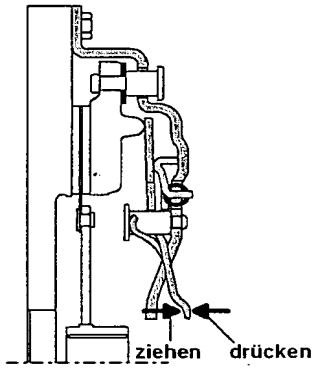
Figur 218



Figur 219

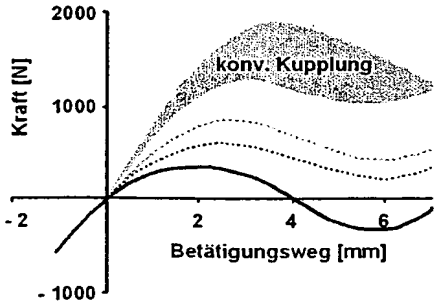
··· SAC II
▬ SAC II mit 30% reduziertem Übertragungsmoment

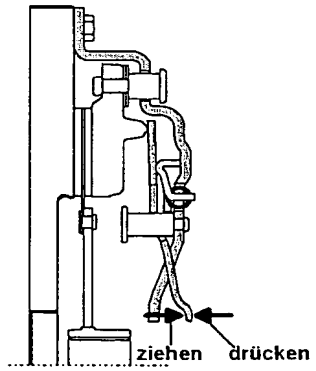




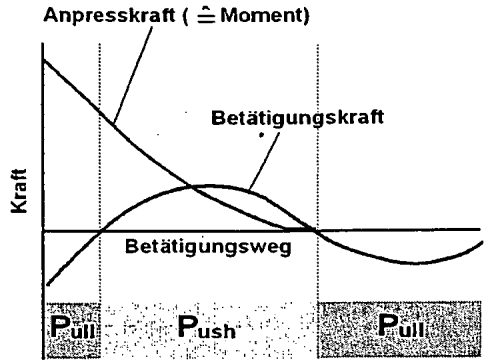
Figur 220

··· SAC II
··· SAC II mit 30% reduziertem Übertragungsmoment
▬ PPP Kupplung

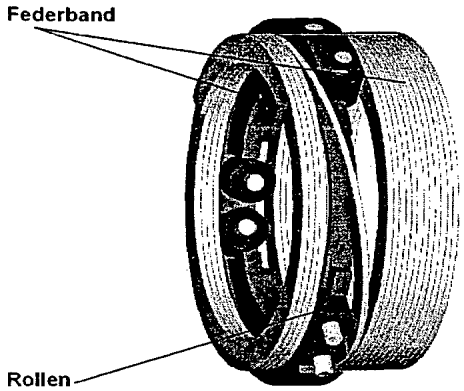




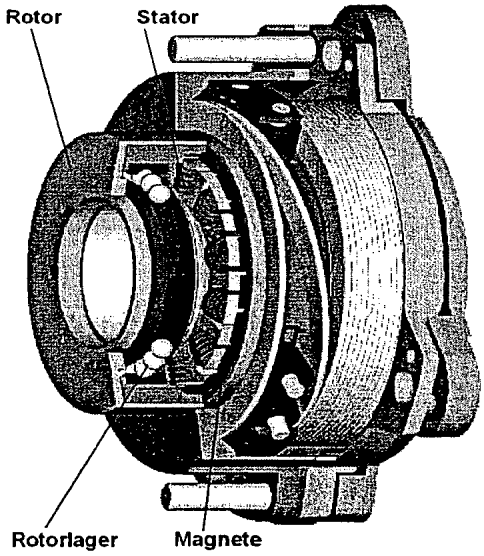
Figur 221



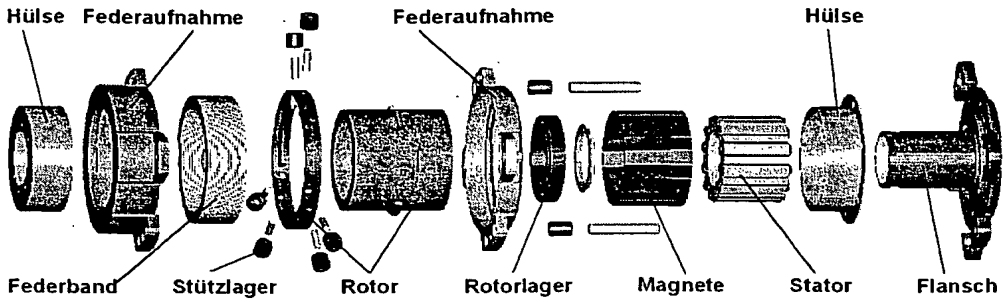
Figur 222



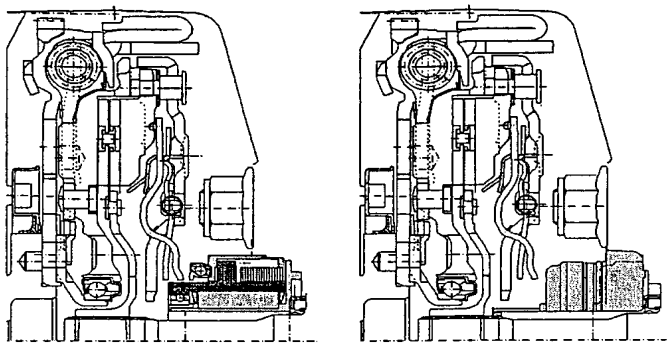
Figur 223



Figur 224



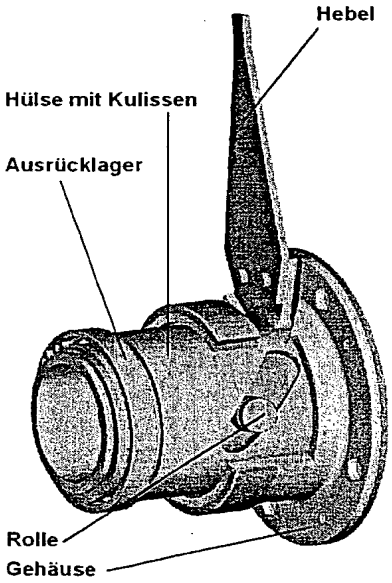
Figur 225



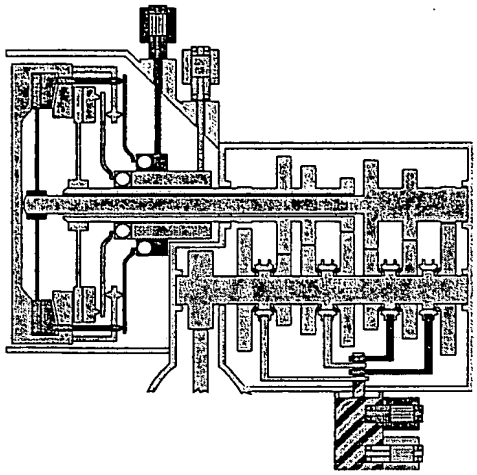
Kupplungsbetätigung mit integrierter Aktorik (EZA)

Serienstand mit CSC

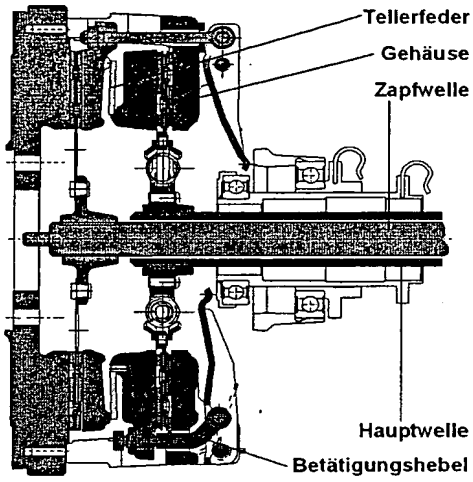
Figur 226



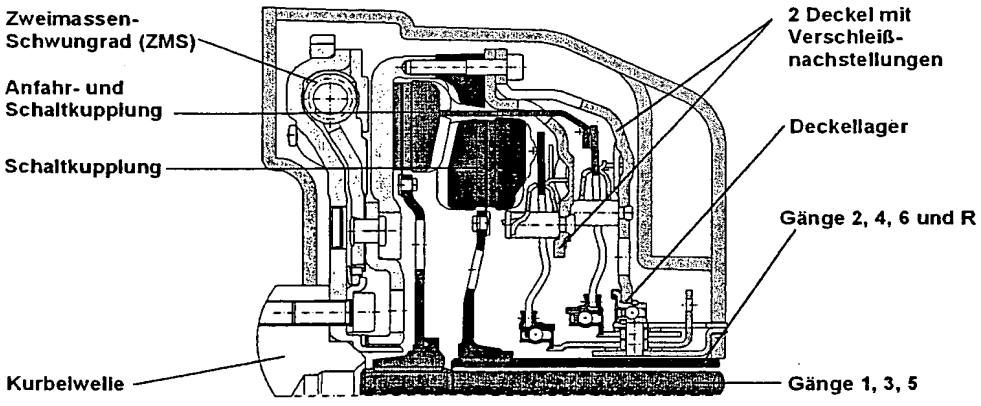
Figur 227



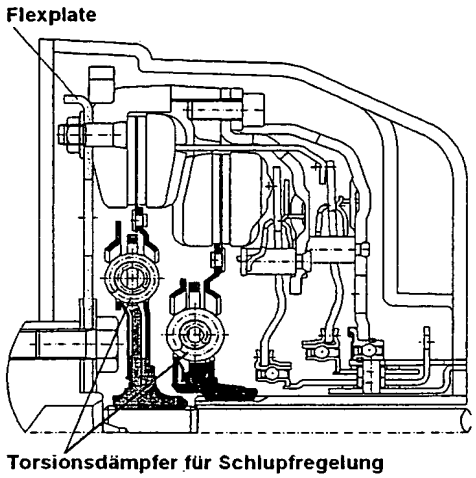
Figur 228



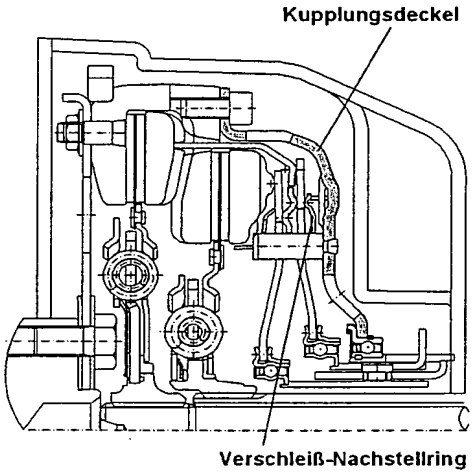
Figur 229



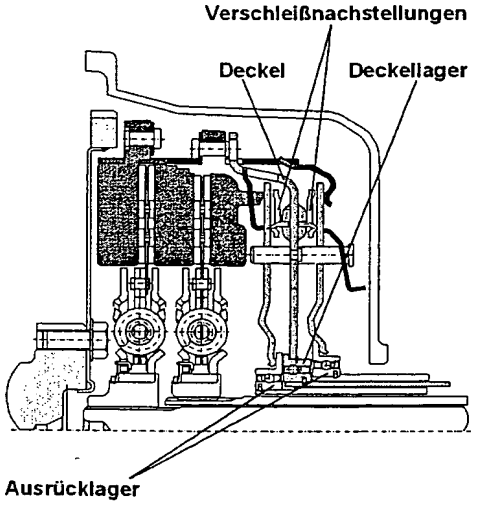
Figur 230



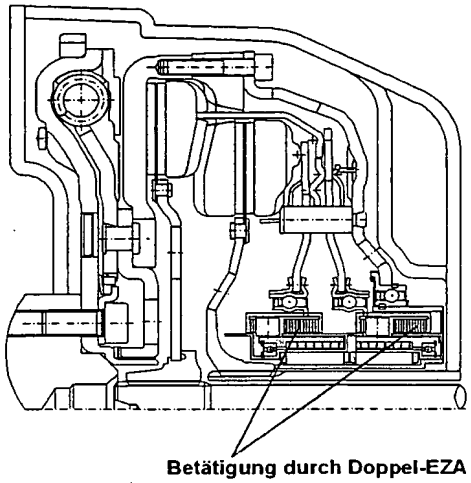
Figur 231



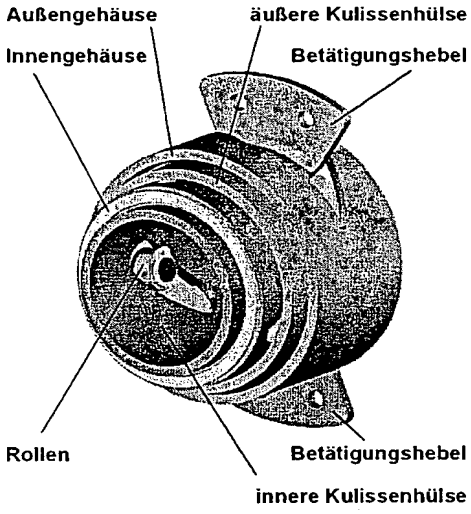
Figur 232



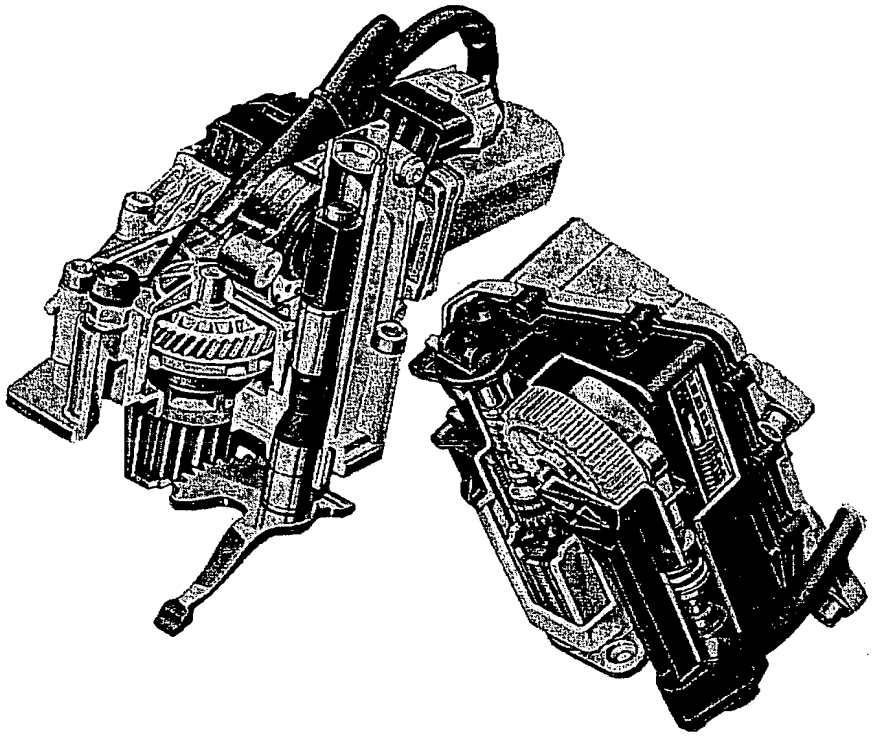
Figur 233



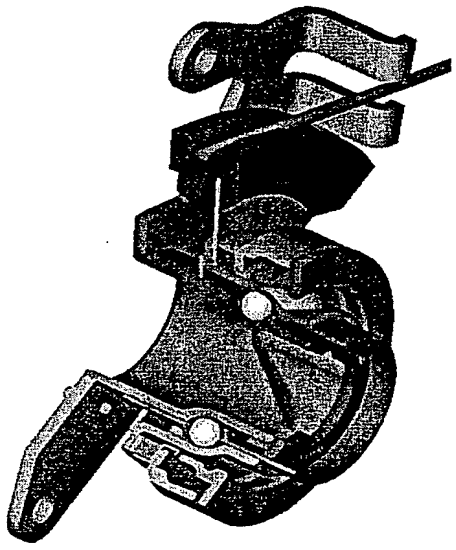
Figur 234



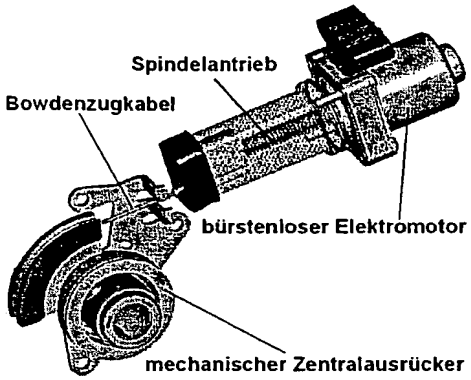
Figur 235



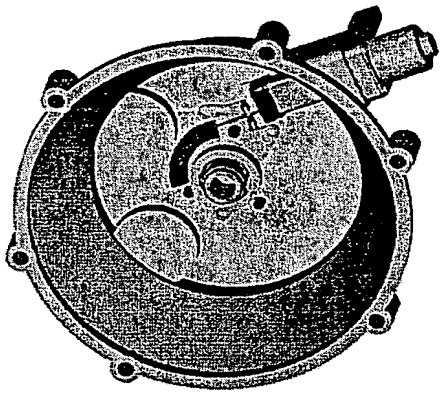
Figur 236



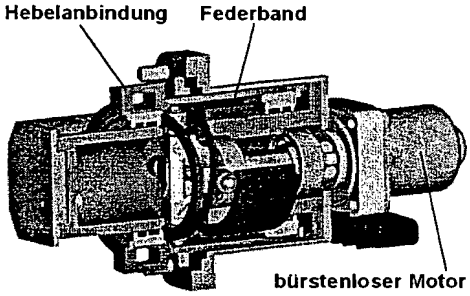
Figur 237



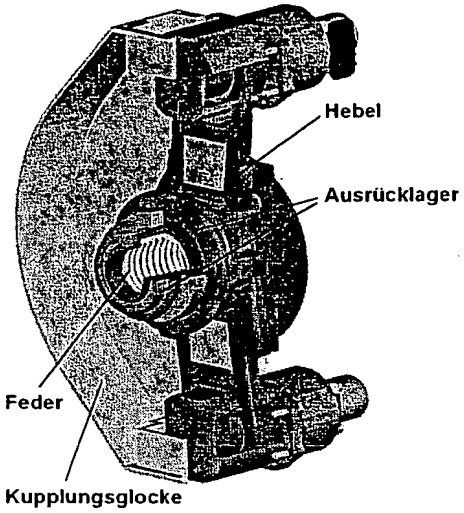
Figur 238



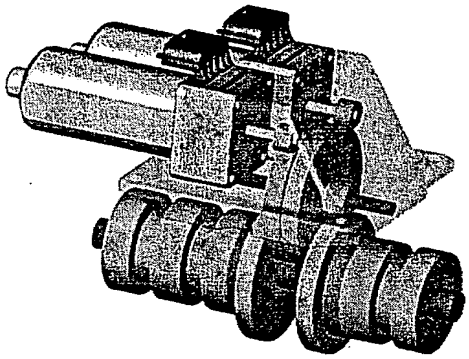
Figur 239



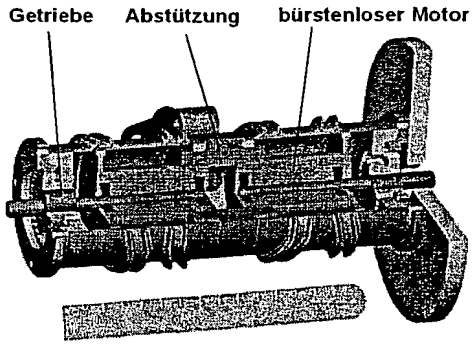
Figur 240



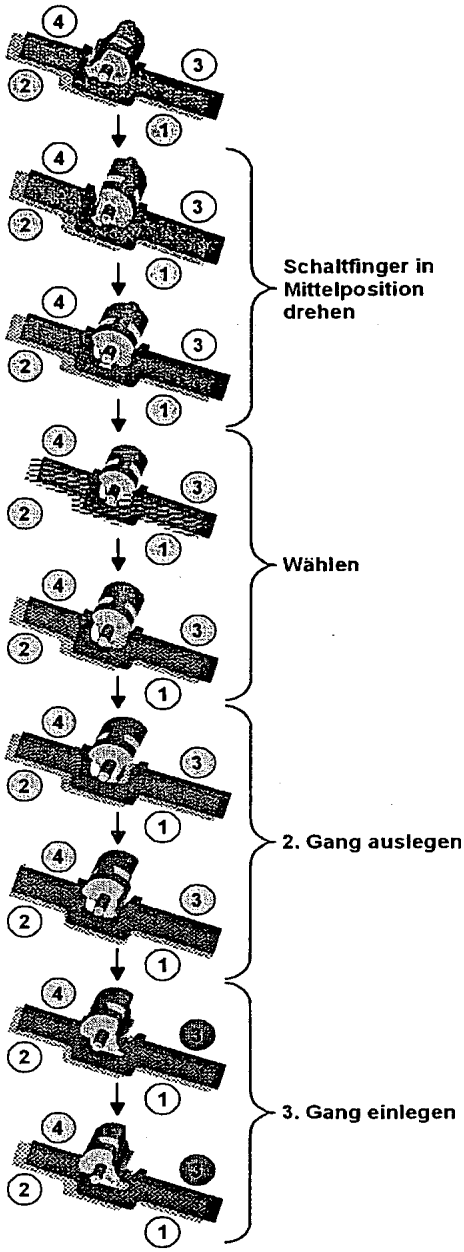
Figur 241



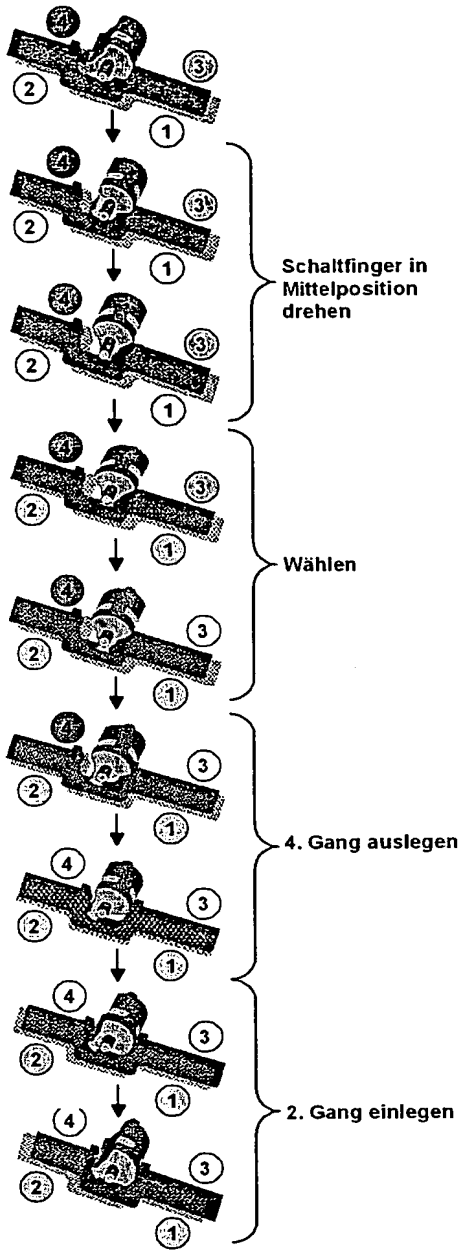
Figur 242



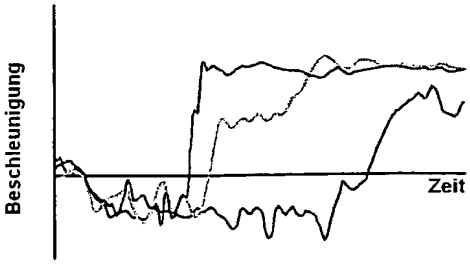
Figur 243


Schaltfinger in Mittelposition drehen
Wählen
2. Gang auslegen
3. Gang einlegen

Figur 244

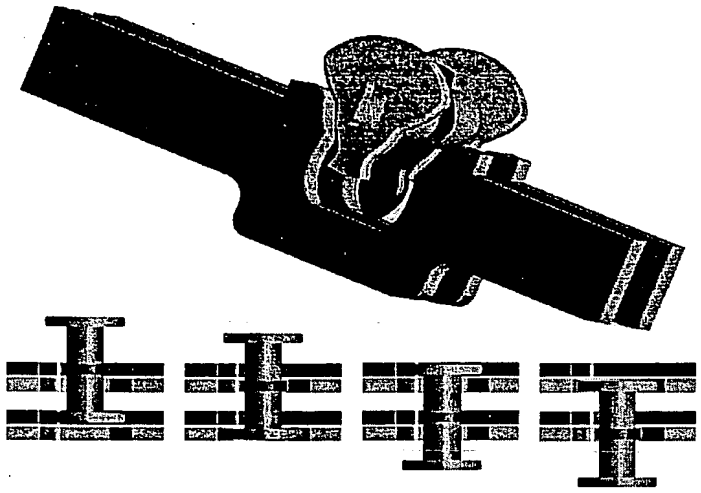


Figur 245



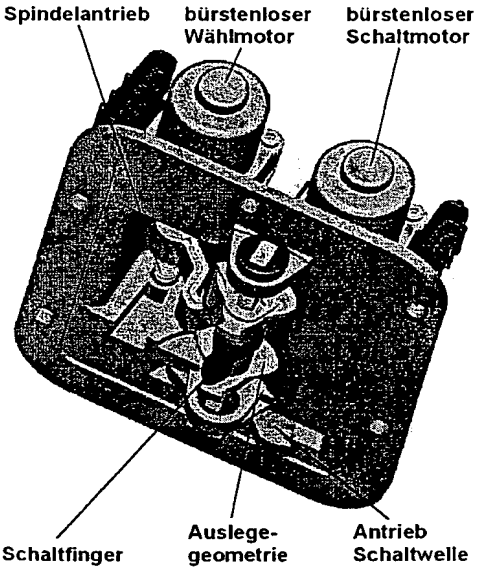
- LuK ASG mit Active Interlock 5 → 2
- LuK ASG 5 → 2
- Schaltwalze 5 → 3

Figur 246

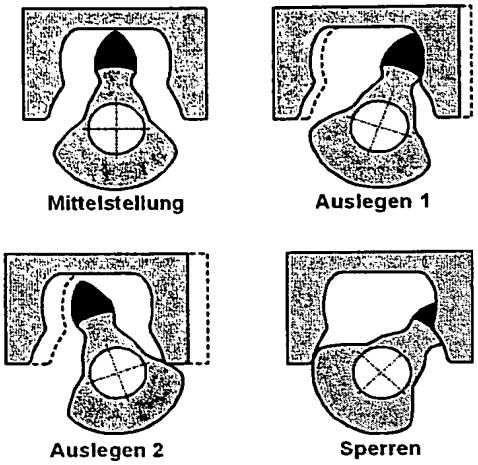


Schaltschienen gerade Gänge
Schaltschienen ungerade Gänge
Schaltfinger
Auslegegeometrien

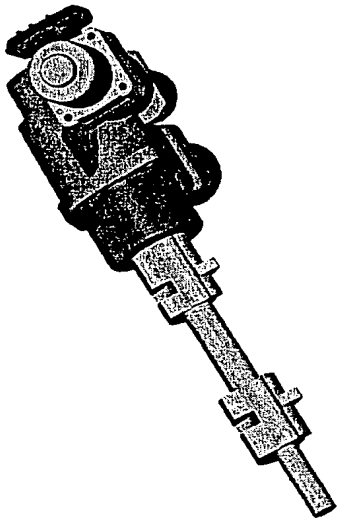
Figur 247



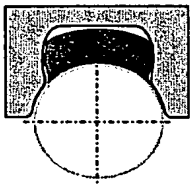
Figur 248



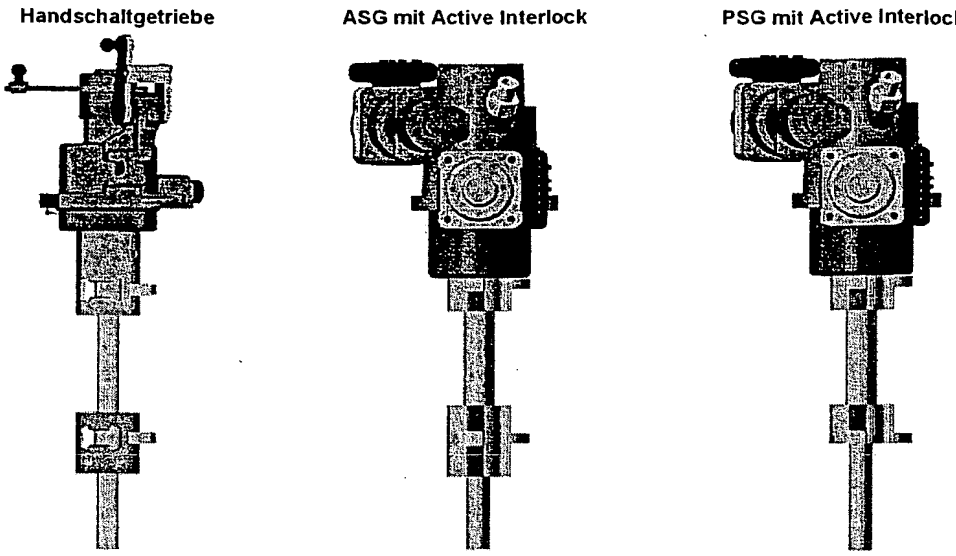
Figur 249



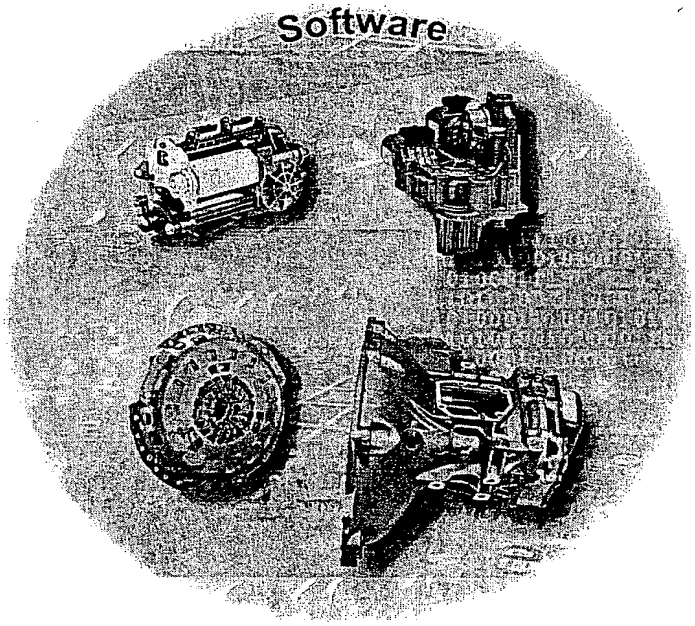
Figur 250



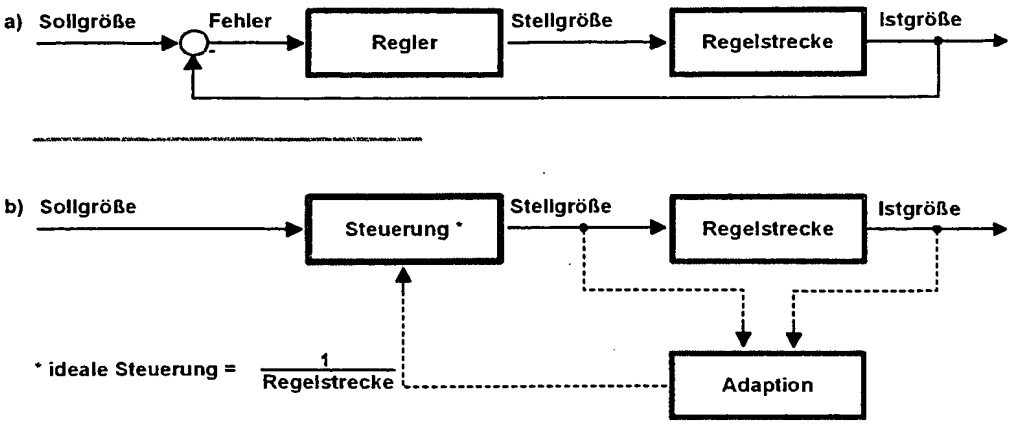
Figur 251



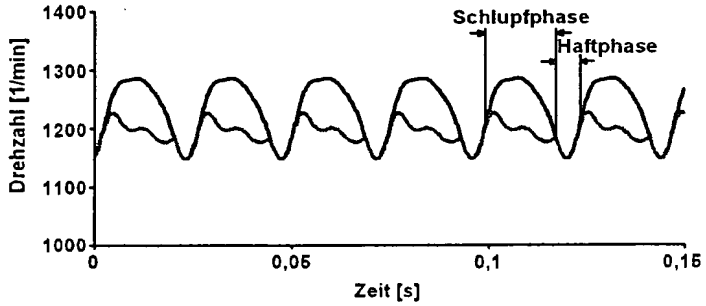
Figur 252



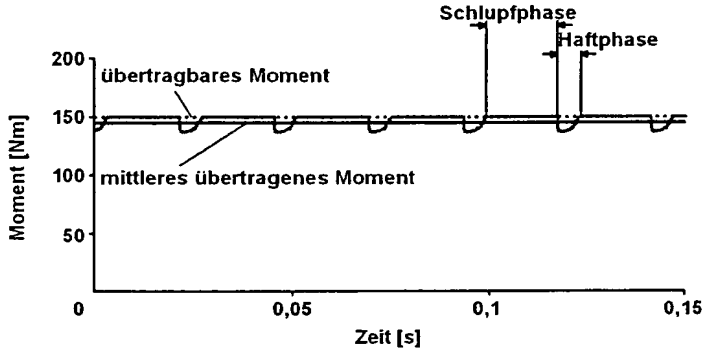
Figur 253



Figur 254

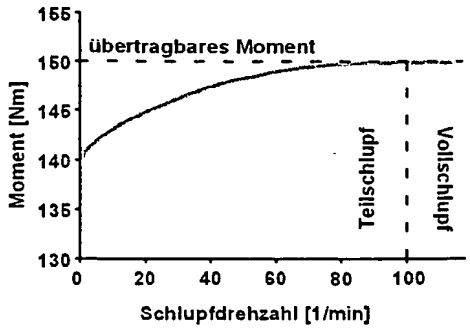


Motordrehzahl
Kupplungsdrehzahl



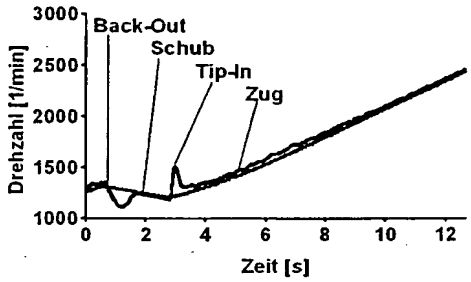
übertragenes Moment

Figur 255

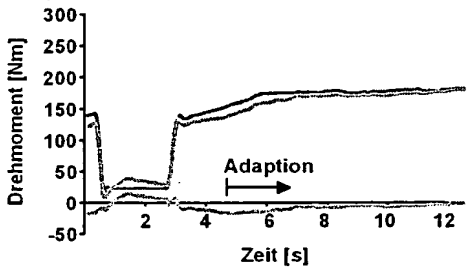


mittleres übertragenes Moment bei konstanter Anpresskraft

Figur 256

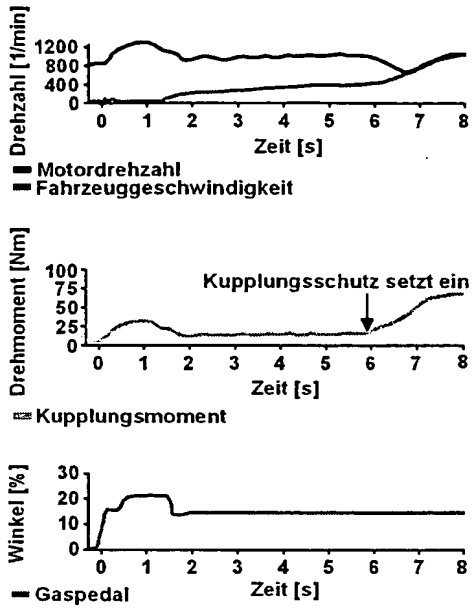


Motordrehzahl
Getriebeeingangsdrehzahl

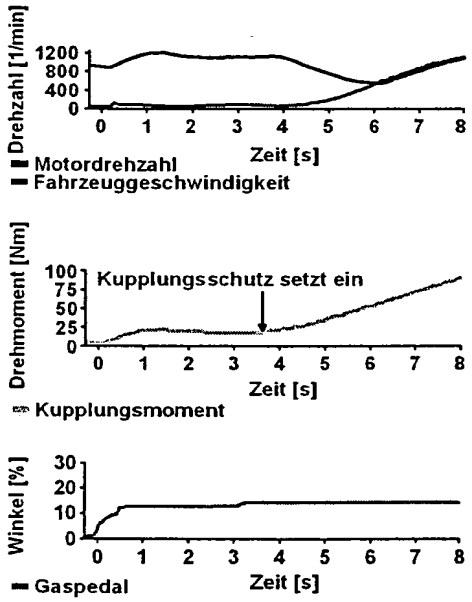


Gesamtmoment
Steuerungsanteil
Regelungsanteil

Figur 257



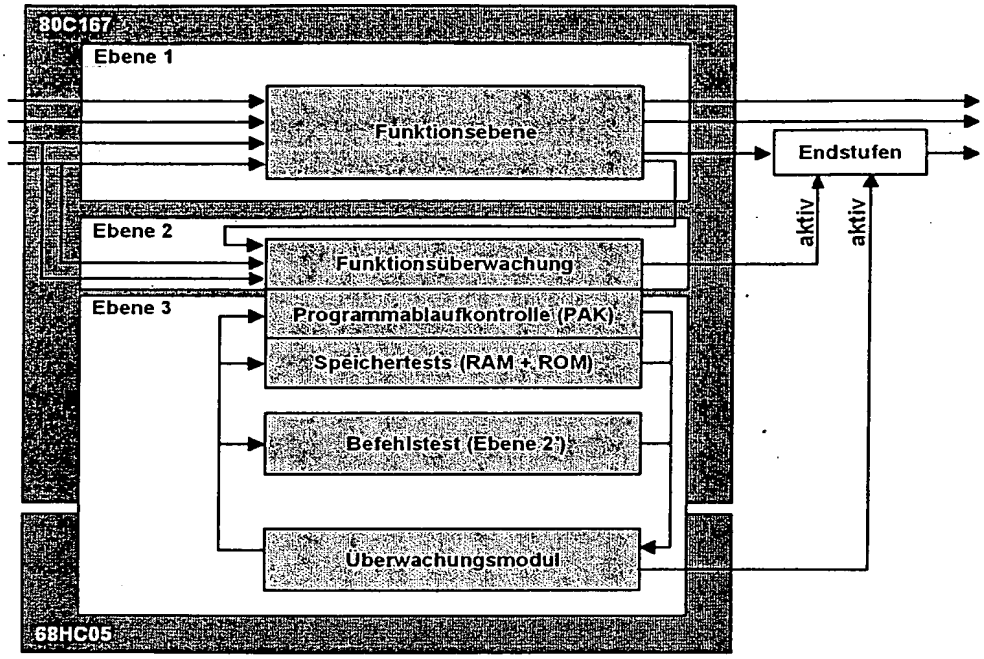
Figur 258



Figur 259

		Situation		
		Geschlossen	Zwischen-stellung	Geöffnet
Reaktion	Schließen	✓	?	↯
	Öffnen	↯	?	✓
	Stehenbleiben	✓	✓	✓

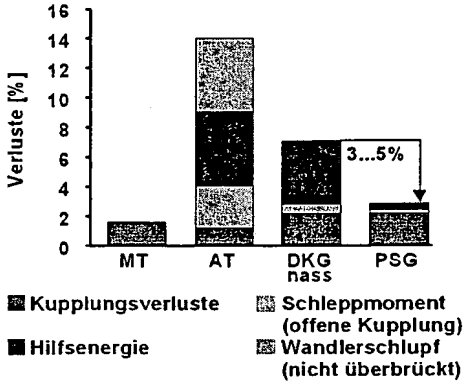
Figur 260



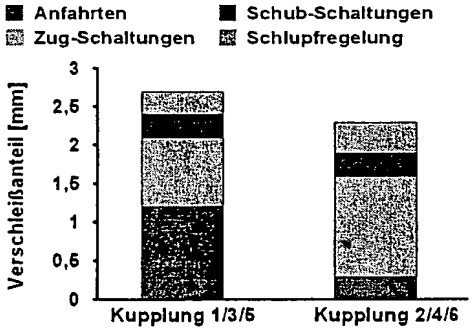
Figur 261

	Trocken-kupplung	Nass-kupplung
Verbrauch		
Überlastbarkeit Berganfahrten		
Option für modulare Familien		
Bauraum/ Gewicht		
Verhalten bei Ausfall		
Schaltqualität Regelbarkeit		

Figur 262

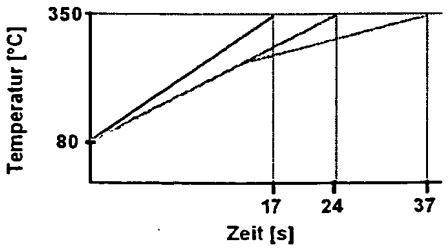


Figur 263



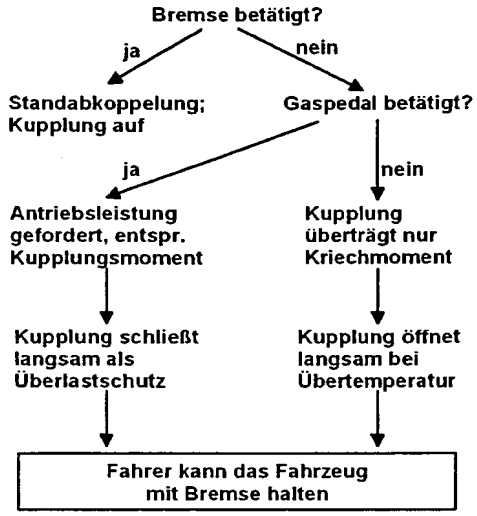
Fahrzeug	2000 kg
Motor	400 Nm
Kupplungen	Durchmesser 250/220
Lebensdauer	240 000 km

Figur 264

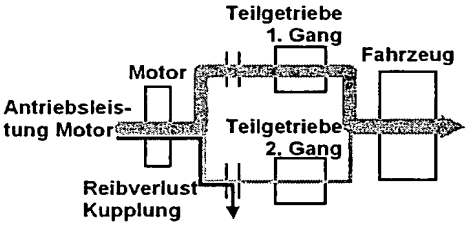


Fall 1: 1. Gang wie Handschalter
Fall 2: 1. Gang 20% kürzer
Fall 3: Anfahren über beide Kupplungen

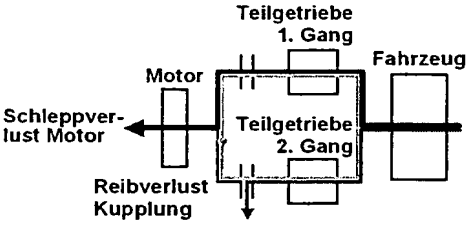
Figur 265



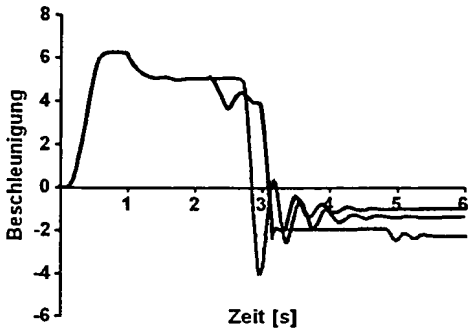
Figur 266



Figur 267

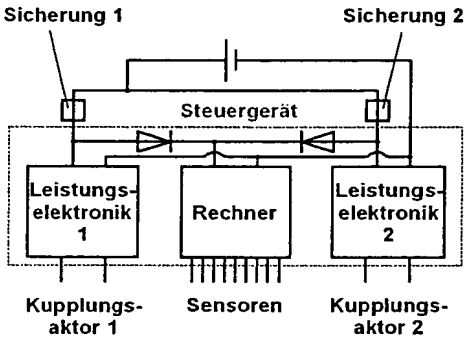


Figur 268

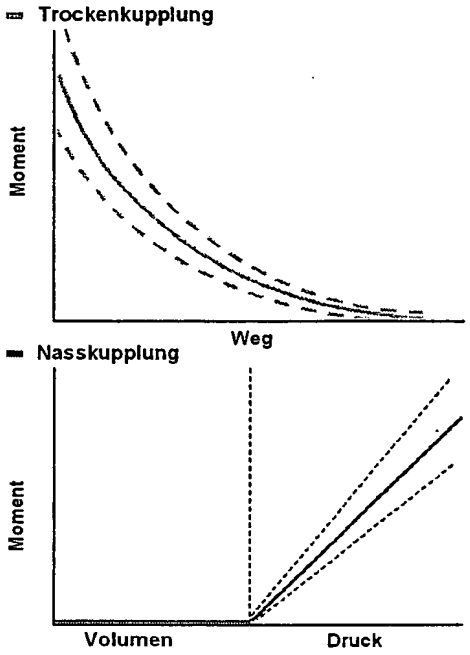


- 1. Gang: Zug -> Schub-Wechsel
- Ausfall bei 1 -> 2 Schaltung, danach Zug-Schub-Wechsel
- Ausfall bei 1 -> 2 Schaltung, danach Zug -> M_{mot} = 0 Nm

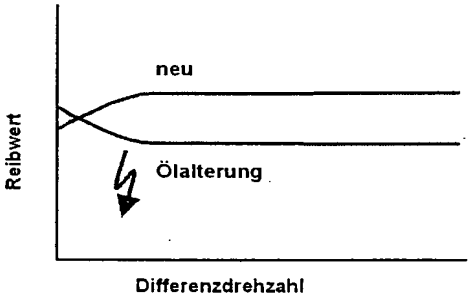
Figur 269



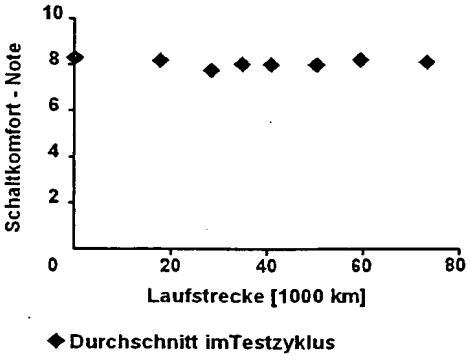
Figur 270



Figur 271

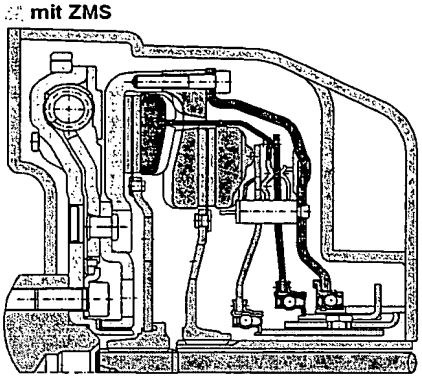


Figur 272

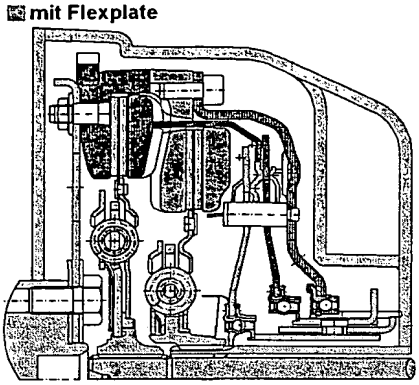


Figur 273

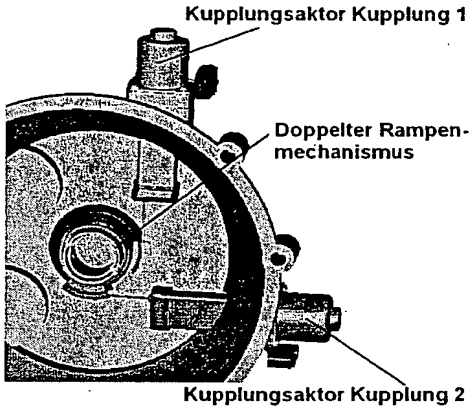
mit ZMS



mit Flexplate



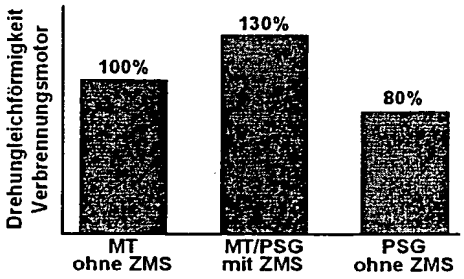
Figur 274



Figur 275

	ohne ZMS	mit ZMS
MT / ASG	0,2 kgm^2	0,25 kgm^2
PSG	0,25 kgm^2	0,35 kgm^2

Figur 276

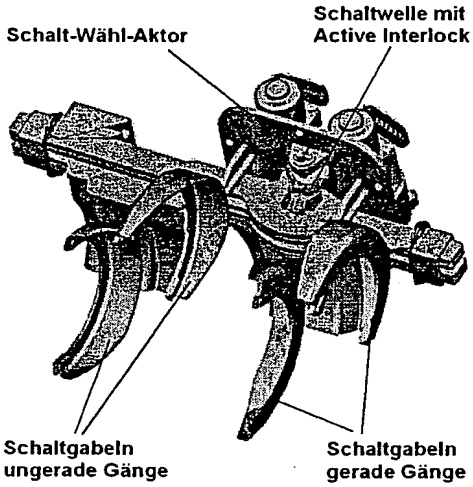


Figur 277

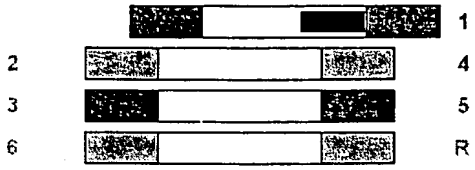
	Mehrverbrauch	
	Manueller Modus	Automatik Modus
Optimierung Motorbetriebspunkt	± 0%	-5,0%
Reduktion Massenträgheit	-0,5%	-0,5%
Schlupfregelung	+0,5%	+1,0%
Bilanz	± 0%	-4,5%

beispielhafter Durchschnittswert

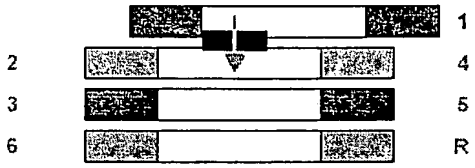
Figur 278



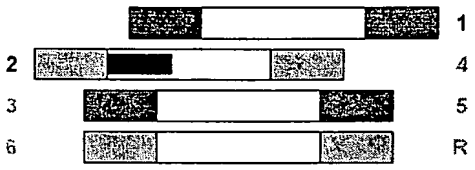
Figur 279



1. Schritt: Gang 1 einlegen

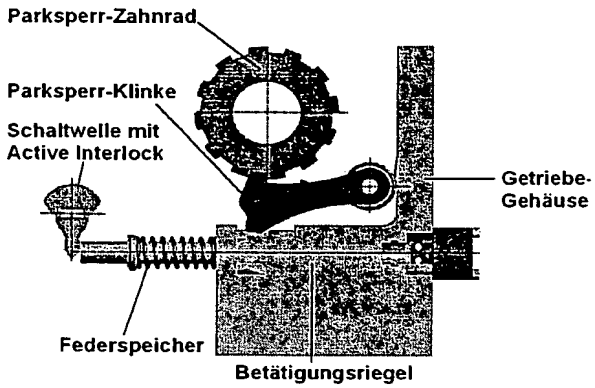


2. Schritt: wählen

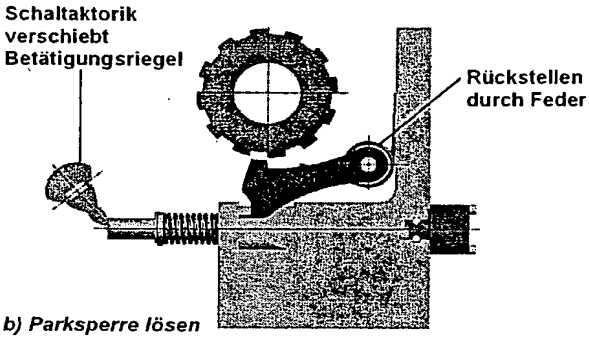


3. Schritt: zusätzlich Gang 2 einlegen

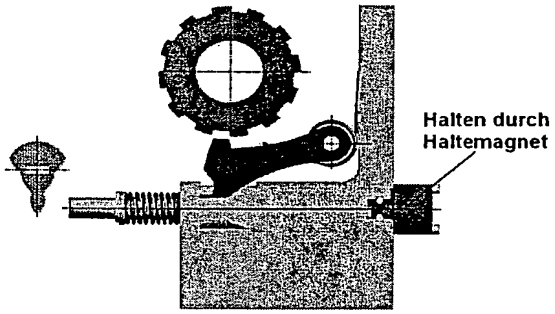
Figur 280



a) Parksperre betätigt

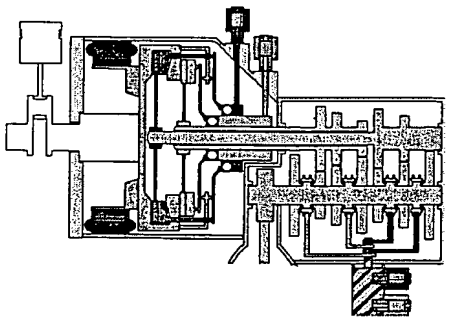


b) Parksperre lösen

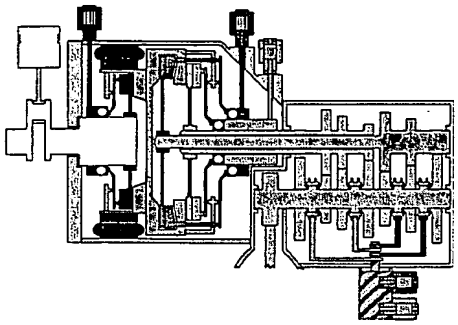


c) Parksperre offen halten

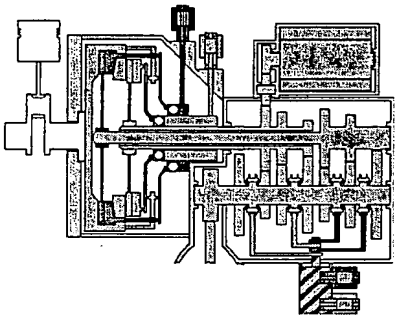
Figur 281



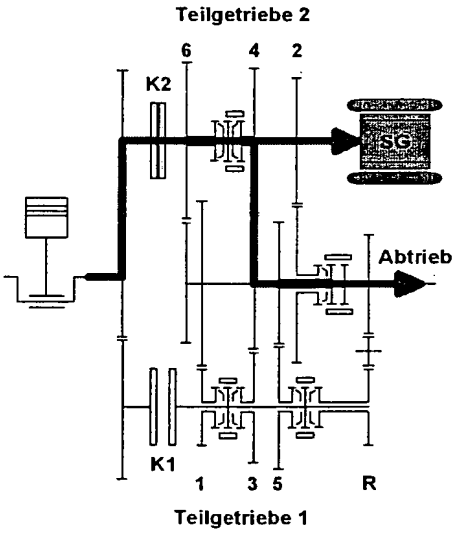
Figur 282



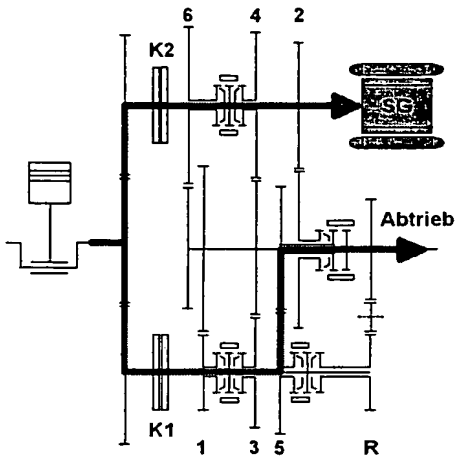
Figur 283



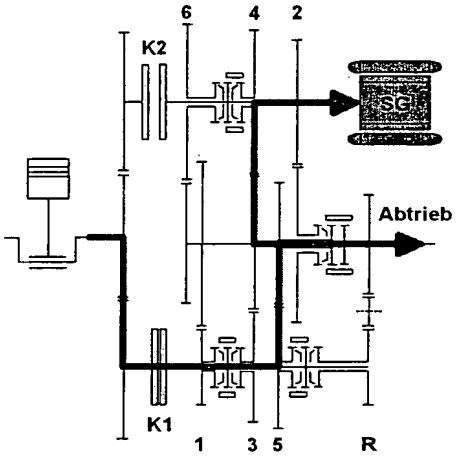
Figur 284



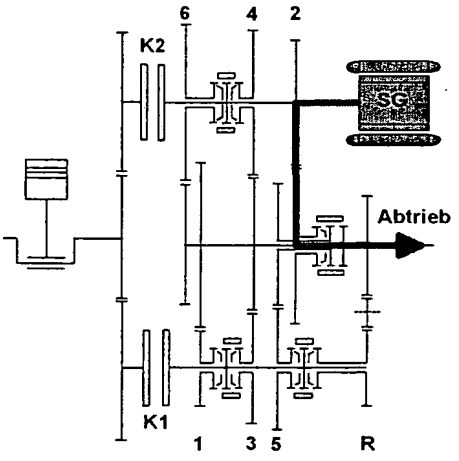
Figur 285



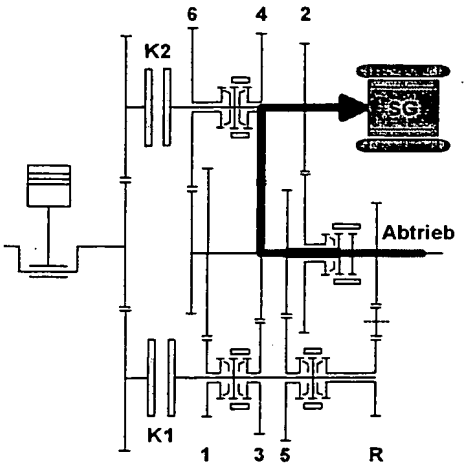
Figur 286



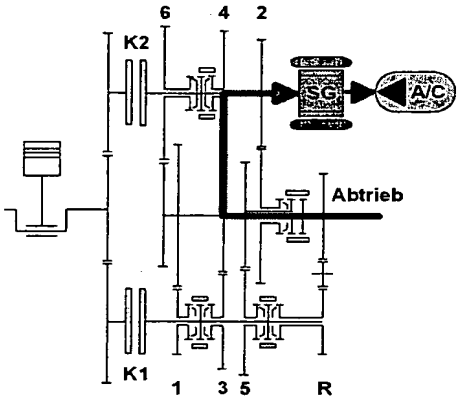
Figur 287



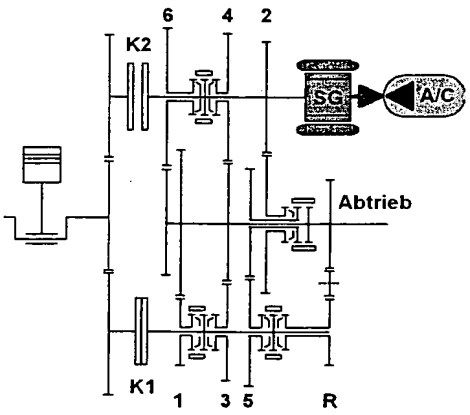
Figur 288



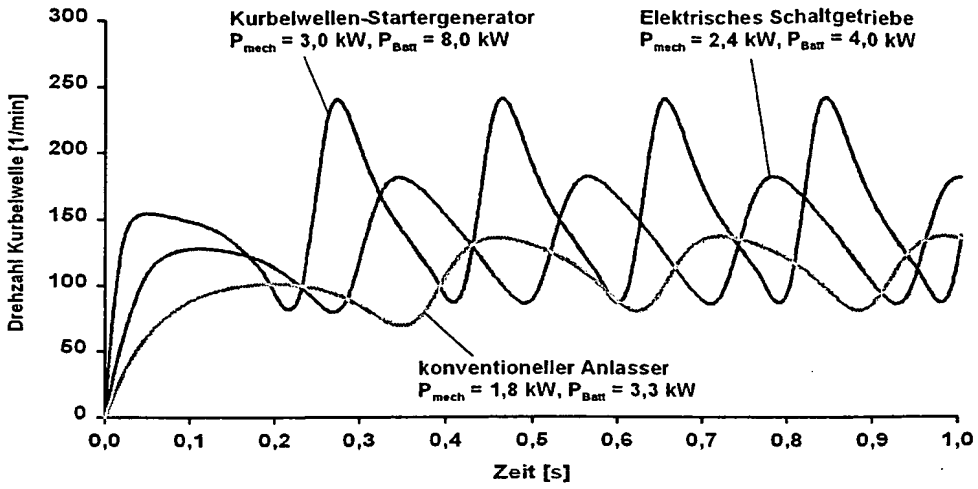
Figur 289



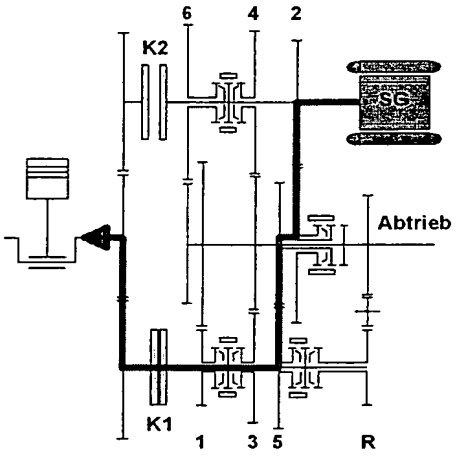
Figur 290



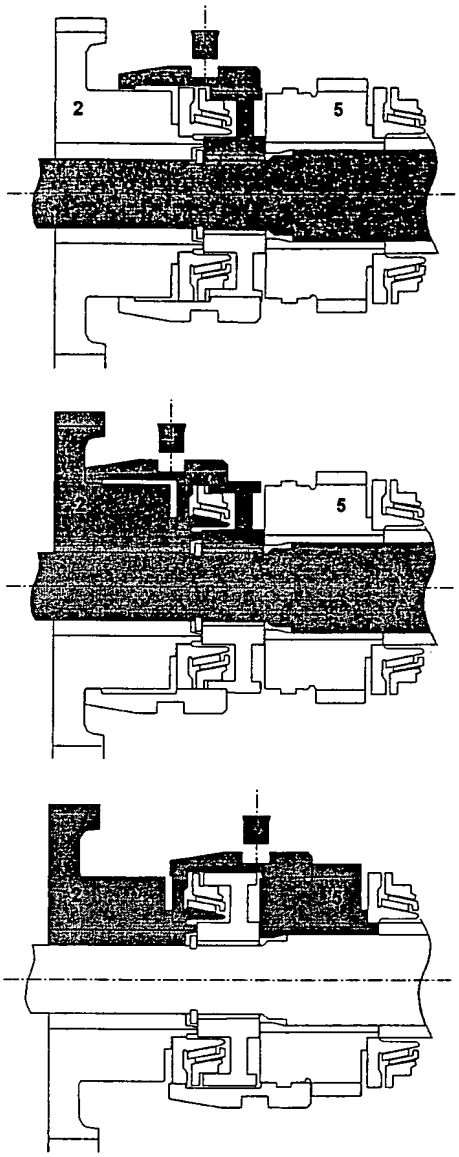
Figur 291



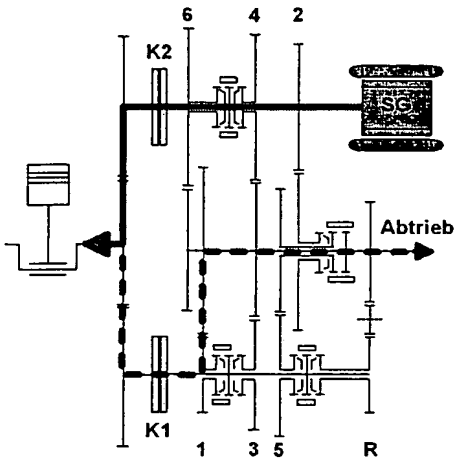
Figur 292



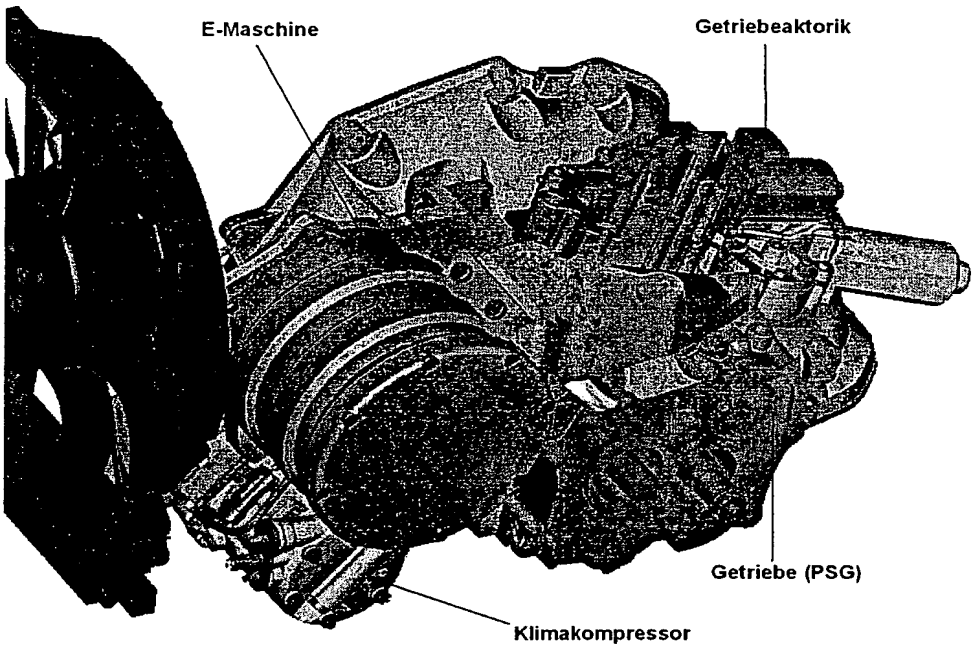
Figur 293



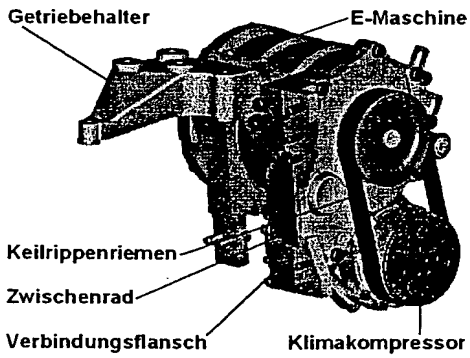
Figur 294



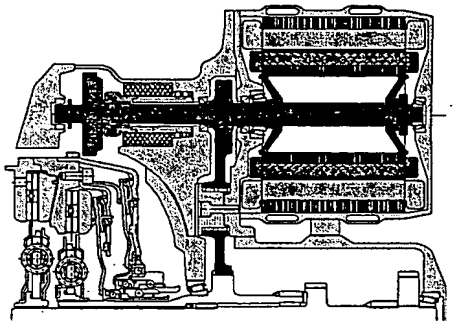
Figur 295



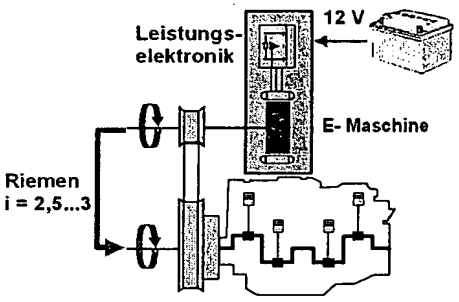
Figur 296



Figur 297

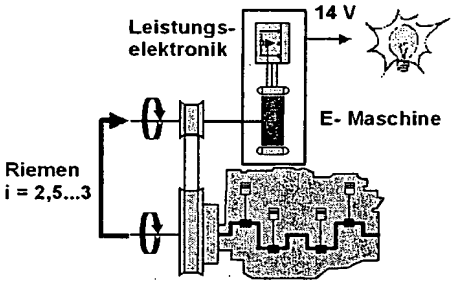


Figur 298



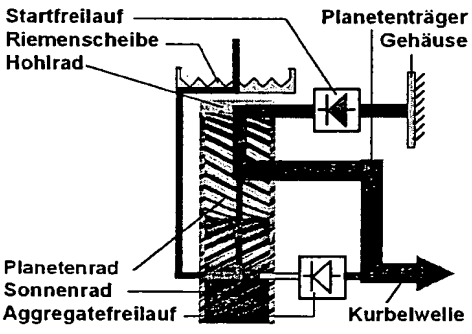
ohne Getriebe i = 1
mit Getriebe i = 2,5...3,5

Figur 299

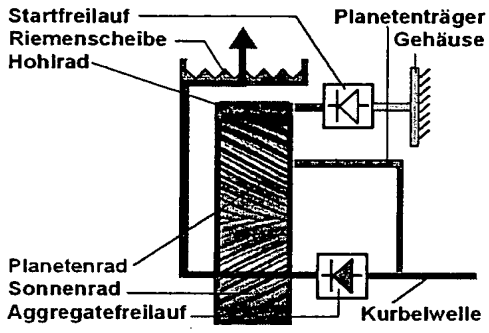


i = 1 mit und ohne Getriebe

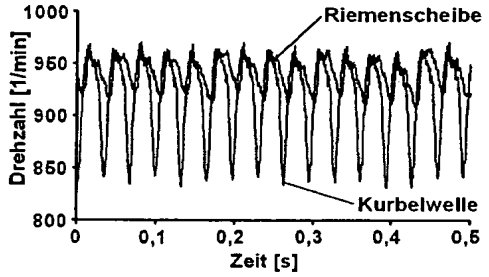
Figur 300



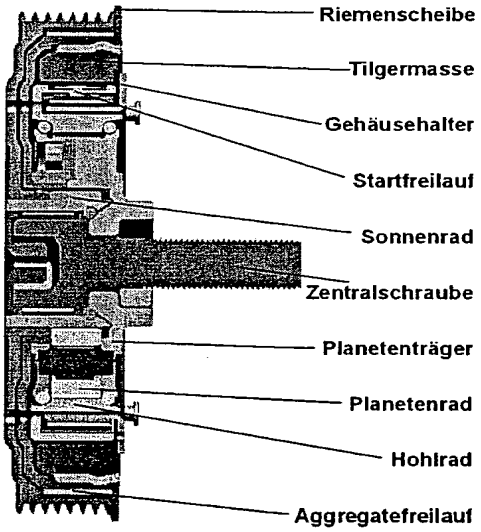
Figur 301



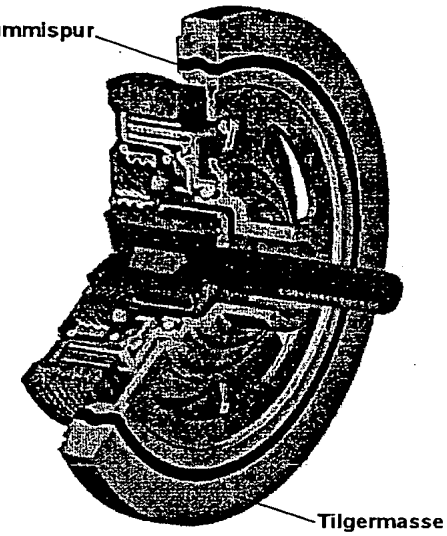
Figur 302



Figur 303



Figur 304



Figur 305